SOIL SURVEY OF

GRANT COUNTY, OREGON, CENTRAL PART

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
Oregon Agricultural Experiment Station

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all who need the information, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in the period 1960–75. Soil names and descriptions were approved in 1975. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1975. This survey was made cooperatively by the Soil Conservation Service, the Oregon Agricultural Experiment Station, and Grant County. It is part of the technical assistance furnished to the Grant Soil and Water Conservation District.

Soil maps in this survey may be copied without permission, but any enlargement of these maps can cause misunderstanding of the detail of mapping and result in erroneous interpretations. Enlarged maps do not show small areas of contrasting soils that could have been shown at a larger mapping scale.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms, ranches, and woodland; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Grant County, Oregon, Central Part, are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the survey area in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the page for the woodland group, wildlife group, and range site in which the soil has been placed.

Individual colored maps that show the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the capability units, range sites, woodland groups, and wildlife groups.

Foresters and others can refer to the section "Woodland," where the soils of the county are grouped according to their suitability for trees.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Wildlife."

Ranchers and others can find, under "Range," groupings of the soils according to their suitability for range, and also the names of many of the plants that grow on each range site.

Engineers and builders can find, under "Engineering," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation, Morphology, and Classification of the Soils."

Newcomers in Grant County, Central Part, may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the survey area given at the beginning of the publication and in the section "General Nature of the Area."

Cover: Landscape showing irrigated Powder soils, foreground; Hack soils on the low terraces, center; Simas soils on the sloping grassland; and Piersonte and Laycock soils in the timbered area of the Aldrich Mountains, background.

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UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE OREGON AGRICULTURAL EXPERIMENT STATION

GRANT COUNTY, Central Part, is in east-central part of Oregon (fig. 1). Canyon City, the county seat, has a population of 640. The survey area has a total area of 462,500 acres, or about 722 square miles.

The survey area is in the Upper Snake River Lava Plains and Hills and the Northern Rocky Mountains Major Land Resource Areas. The main fork of the John Day River has cut a valley that extends in an east-west direction through the center of the survey area. Elevation ranges from about 2,100 feet in the southwestern corner to about 5,500 feet in the north and south central parts.

The survey area is bounded by Wheeler County on the west, the Malheur National Forest on the north and south sides, and the Wallowa-Whitman National Forest on the east side. Grant County, Oregon, Central Part, extends from about 19 miles east to about 35 miles west of the city of John Day. It extends about 6 miles north and about 6 miles south of the main fork of the John Day River. About 80 percent is privately owned, and most of the remaining 20 percent is managed by the U.S. Bureau of Land Management.

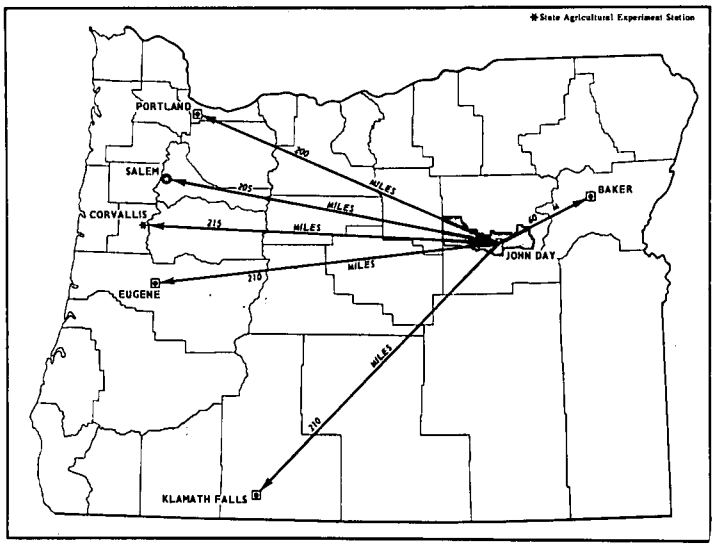

Figure 1.—Location of Grant County, Central Part, in Oregon.

The area is divided into three general areas: a narrow, relatively smooth valley along the river that is used mainly for irrigated hay and pasture, a middle elevation, hilly and mountainous area about 3 miles wide on each side of the valley that is used mainly for range, and a high elevation, mountainous area that is used mainly for timber production and cattle grazing.

The survey area is drained by the main fork of the John Day River which runs from east to west through the center of the area. This fork has numerous small tributaries that approximately parallel each other at about right angles to the fork. The south fork of the John Day River, a major tributary, joins the main fork at Dayville, near the western boundary of the area. Nearly all the area drained by the south fork of the John Day River is outside the survey area.

In mapping the relatively smooth valley part of the survey area, the soils were examined at closer intervals and were mapped in considerably more detail than in the other two parts of the survey area.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soils are in the survey area, where they are located, and how they can be used. The soil scientists went into the area knowing they likely would locate many soils they already knew something about and identify many they had never seen before. They observed the steepness, length, and shape of slopes, the size of streams and the general pattern of drainage, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has been changed very little by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Soil series commonly are named for towns or other geographic features near the place where they were first observed and mapped. Dayville and Courtrock, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in characteristics.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Hack loam, 3 to 7 percent slopes, is one of several phases within the Hack series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map in the back of this publication was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of ranches, farms, and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a named soil phase.

Some mapping units are made up of soils of different series or of different phases within one series, and some have little or no soil. These kinds of mapping units are discussed in the section "Descriptions of the Soils."

While a soil survey is in progress, samples of soils are taken as needed for laboratory measurements and for engineering tests. Existing ratings of suitabilities and limitations (interpretations) of the soils are field tested and modified as necessary during the course of the survey, and new interpretations are added to meet local needs. This is done mainly through field observations of behavior of different kinds of soil for different uses under different levels of management. Also, data are assembled from other sources, such as test results, records, field experience, and other information available from state and local specialists. For example, data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so it will be readily useful to different groups of users, among them farmers, managers of rangeland and woodland, engineers, planners, developers and builders, homebuyers, and those seeking recreation. Presenting the detailed information in an organized, understandable manner is the purpose of this publication.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Grant County, Oregon, Central Part. A soil association is a landscape that has a distinctive pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soil. The kinds of soil in one association may occur in another soil association but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in an area, who want to compare different parts of an area, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field, or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The soil associations in Grant County, Oregon, Central Part, are described in the following pages. For more detailed information about the individual soils in each association, refer to the detailed map and to the section "Descriptions of the Soils."

1. Hack-Veazie-Dayville Association

Well drained to somewhat poorly drained, deep loams and silt loams on flood plains and alluvial fans; 12 to 18 inches precipitation

Slopes range from 0 to 20 percent. The average annual air temperature ranges from 45° to 52° F, and the frost free period is 90 to 150 days. Elevation ranges from 2,100 to 3,800 feet. In uncultivated areas, the vegetation on the well drained soils is bunchgrasses, forbs, and shrubs. The somewhat poorly drained soils have sedges, rushes, and tufted hairgrass.

This association makes up about 7 percent of the survey area. It is about 30 percent Hack soils, 30 percent Veazie soils, and 20 percent Dayville soils (fig. 2). Ricco, Courtrock, Boyce, and Powder soils make up about 20 percent.

Hack soils are typically deep, well drained loams. Veazie soils are deep, well drained loams. Dayville soils are deep, somewhat poorly drained silt loams.

These soils are used mainly for hay. Alfalfa or alfalfa and grass is grown on the well drained soils. Grass or grass and sedges is grown on the somewhat poorly drained soils. These soils provide wildlife habitat for quail, pheasant, and deer.

2. Gwin-Rockly-Lickskillet Association

Well drained, shallow very stony or extremely stony loams and silt loams over bedrock on uplands; 11 to 20 inches precipitation

These soils are mainly on ridgetops and south facing

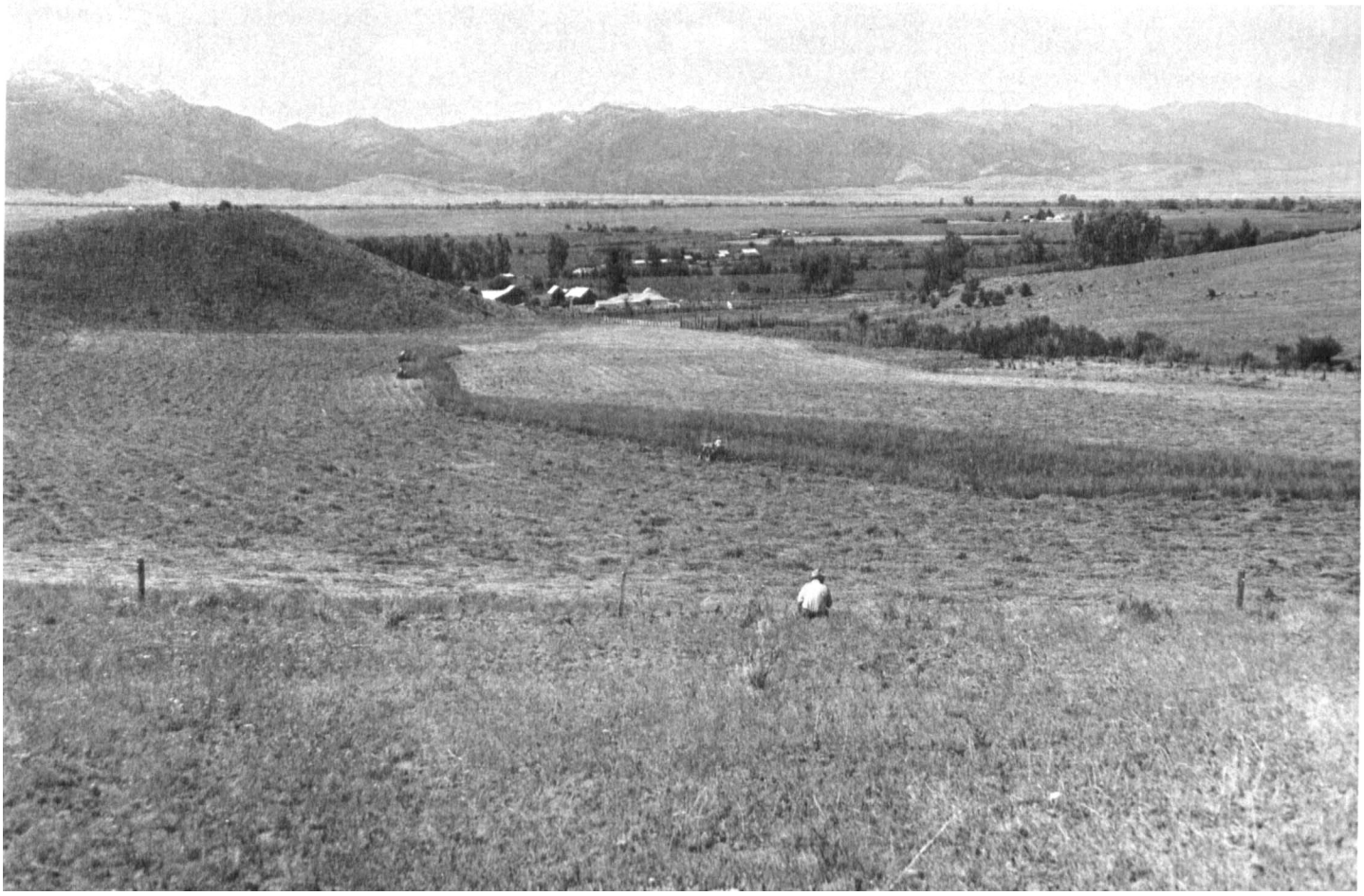

Figure 2.—Hack-Veazie-Dayville association on the flood plain and alluvial fans, Oxwall-Oxbow association on the old terrace, and Lemonex-Laycock-Logdell association on the timbered upland.

slopes. Slopes range from 2 to 70 percent. The average annual air temperature ranges from 42° to 51° F, and the frost free period is 50 to 150 days. Elevation ranges from 2,100 to 5,200 feet. The vegetation consists of bluebunch wheatgrass, Sandberg bluegrass, Idaho fescue, and some shrubs and forbs.

This association makes up about 22 percent of the survey area. It is about 35 percent Gwin soils, 20 percent Rockly soils, and 15 percent Lickskillet soils. Snell, Venator, Balder, Grell, Wrightman, and Anatone soils and Rock outcrop make up about 30 percent.

Gwin soils are shallow, well drained very stony or extremely stony silt loams. Rockly soils are shallow, well drained extremely stony loams. Lickskillet soils are shallow, well drained extremely stony loams that are generally mapped with Rock outcrop.

These soils are used mainly for range and wildlife habitat.

3. Oxwall-Oxbow Association

Well drained, shallow and moderately deep, very stony and extremely stony silty clay loams over a hardpan on terraces; 14 to 18 inches precipitation

Slopes are 2 to 7 percent. The average annual air temperature is 47° to 50° F, and the frost free period is 90 to 140 days. The vegetation consists of bluebunch wheatgrass, Sandberg bluegrass, Idaho fescue, and Canby bluegrass.

This association makes up about 8 percent of the survey area. It is about 65 percent Oxwall soils and 25 percent Oxbow soils. Tub and Simas soils make up about 10 percent.

Oxwall soils are shallow, well drained very stony and extremely stony silty clay loams over an indurated hardpan. Oxbow soils are moderately deep, well drained very stony silty clay loams over an indurated hardpan.

These soils are used mainly for range and wildlife habitat. About 2,500 acres of the Oxbow soil is used for irrigated pasture and hay.

4. Simas-Tub Association

Well drained, deep clay loams and stony or very stony clay loams on uplands; 10 to 14 inches precipitation

Slopes range from 3 to 65 percent. The average annual air temperature is 45° to 50° F, and the frost free period is 90 to 150 days. Elevation ranges from 2,100 to 4,000 feet. The vegetation consists of bluebunch wheatgrass, Sandberg bluegrass, Idaho fescue, forbs, and shrubs.

This association makes up about 26 percent of the

survey area. It is about 70 percent Simas soils and 15 percent Tub soils. Day, Oxbow, and Lickskillet soils and Badland and Rock outcrop make up about 15 percent.

Simas soils are deep, well drained very stony clay loams. Tub soils generally are mapped with Simas soils. They are deep, well drained stony clay loams and clay loams.

These soils are used mainly for range and wildlife habitat. In places dryfarmed small grain grows in small areas of Simas and Tub soils.

5. Waterbury-Ukiah Association

Well drained, shallow and moderately deep stony to extremely stony silty clay loams over bedrock on uplands; 13 to 20 inches precipitation

Slopes range from 2 to 50 percent. The average annual air temperature is 43° to 50° F. The frost free period is 70 to 110 days. The vegetation consists of bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, and low sagebrush.

This association makes up about 16 percent of the survey area. It is about 65 percent Waterbury soils and 20 percent Ukiah soils. Fopiano, Gwin, Rockly, Snell, and Anatone soils and some Rock outcrop make up about 15 percent.

Waterbury soils are shallow, well drained extremely stony silty clay loams. Ukiah soils are moderately deep, well drained stony to extremely stony silty clay loams.

These soils are used mainly for range and wildlife habitat. Dryfarmed small grain grows in small areas of Ukiah soils.

6. Lemonex-Laycock-Logdell Association

Well drained, moderately deep stony and very stony clay loams over serpentine and deep very shaly loams over highly fractured shale, on uplands; 17 to 24 inches precipitation

Slopes range from 3 to 75 percent. The average annual temperature is 40° to 45° F, and the frost free period is 20 to 90 days. The vegetation consists mainly of ponderosa pine, Douglas-fir, elk sedge, and pinegrass.

This association makes up about 9 percent of the survey area. It is about 25 percent Lemonex soils, 15 percent Laycock soils, and 15 percent Logdell soils. Ruddley, Piersonte, Alding, Daxty, and Hankins soils and Rock outcrop make up about 45 percent.

Lemonex soils are moderately deep stony and very stony clay loams. Laycock soils are deep very shaly loams. They generally are mapped with Logdell or Piersonte soils. Logdell soils are deep, very shaly loams. Mountainmahogany, bitterbrush, Idaho fescue, and bluebunch wheatgrass grow on Logdell soils.

These soils are mainly used for timber, grazing, and wildlife habitat. Logdell soils are used for range and wildlife habitat.

7. McGarr-Hankins-Helter Association

Well drained, moderately deep and deep silt loams, silty clay loams, stony and very stony loams on uplands; 16 to 30 inches annual precipitation

Slopes range from 2 to 75 percent. The average annual air temperature is 40° to 45° F, and the frost free period is 10 to 90 days.

This association makes up about 12 percent of the survey area. It is about 35 percent McGarr soils, 25 percent Hankins soils, and 20 percent Helter soils. Top soils, Anatone soils, and Rock outcrop make up about 20 percent of the association.

McGarr soils are moderately deep, well drained stony and very stony loams. Hankins soils are deep, well drained loams and silt loams. Helter soils are deep, well drained silt loams. The vegetation on McGarr and Hankins soils consists of Douglas-fir, ponderosa pine, pinegrass, and elk sedge. The vegetation on Helter soils is Douglas-fir, white fir, western larch, and lodgepole pine.

These soils are used mainly for timber, grazing, and wildlife habitat. Anatone soils are used for range and wildlife habitat.

Descriptions of the Soils

This section describes the soil series and mapping units of Grant County, Oregon, Central Part. A profile of a soil representative of each series is described. To get full information on any one mapping unit, it is necessary to read the description of that unit and also the description of the soil series to which it belongs.

The profile described in the series is representative of mapping units in that series. If the profile of a given mapping unit is different from the one described for the series, these differences are stated in describing the mapping unit. Colors are for moist soil, unless otherwise stated.

In places there is little or no identifiable soil and little or no vegetation. This land is called miscellaneous land areas and is delineated on the map and given descriptive names. Badland is an example. Areas too small to be delineated are identified by special symbols on the soil maps.

Preceding the name of each mapping unit is a symbol. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit are the capability unit, range site, woodland group, and wildlife group in which the mapping unit has been placed. The page for the description of each capability unit and the range site, woodland group, or wildlife group assigned can be learned by referring to the "Guide to Mapping Units" at the back of this survey.

The acreage and proportionate extent of each mapping unit are given in table 1. Additional information on each unit is given in interpretive tables in other sections. Most of the terms used in describing soils are defined in the Glossary or in the Soil Survey Manual (*11*).[1]

Alding Series

The Alding series consists of well drained soils that formed in colluvium weathered from metavolcanic rocks on uplands. Slopes are 30 to 70 percent. Elevation is 3,800 to 5,500 feet. The vegetation is

[1] Italic numbers in parentheses refer to References, p. 127.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Acreage	Percent
Alding-Rock outcrop complex, 30 to 70 percent slopes	5,190	1.1
Anatone-Wrightman complex, 3 to 25 percent slopes	2,800	.6
Balder stony loam, 5 to 15 percent slopes	1,280	.3
Balder very stony loam, 15 to 55 percent slopes	3,940	.8
Boyce silty clay loam	1,040	.2
Courtrock loam, 2 to 7 percent slopes	2,070	.4
Daxty loam, 15 to 40 percent north slopes	900	.2
Daxty-Rock outcrop complex, 3 to 40 percent slopes	1,800	.4
Dayville silt loam	4,300	.9
Dumps	1,140	.2
Fopiano silty clay loam, 2 to 15 percent slopes	1,680	.4
Fopiano silty clay loam, 15 to 40 percent north slopes	3,220	.7
Grell very gravelly loam, 7 to 40 percent south slopes	3,110	.7
Grell very gravelly loam, 15 to 40 percent north slopes	920	.2
Gwin-Rockly complex, 3 to 40 percent slopes	35,520	7.7
Gwin-Rockly complex, 40 to 70 percent slopes	12,530	2.7
Gwin-Rock outcrop complex, 40 to 70 percent slopes	8,420	1.8
Hack loam, 0 to 3 percent slopes	2,750	.6
Hack loam, 3 to 7 percent slopes	1,620	.4
Hack loam, 7 to 12 percent slopes	1,670	.4
Hack gravelly loam, 3 to 15 percent slopes	990	.2
Hack extremely stony loam, 3 to 20 percent slopes	530	.1
Hankins silt loam, 10 to 45 percent north slopes	2,590	.6
Hankins silty clay loam, 5 to 35 percent slopes	10,080	2.2
Helter silt loam, 3 to 15 percent slopes	3,650	.8
Helter silt loam, 15 to 40 percent slopes	5,570	1.2
Helter silt loam, 40 to 60 percent slopes	970	.2
Laycock-Logdell complex, 15 to 45 percent north slopes	2,570	.6
Laycock-Logdell complex, 15 to 45 percent south slopes	4,170	.9
Laycock-Logdell complex, 45 to 75 percent south slopes	1,910	.4
Lemonex stony clay loam, 10 to 45 percent slopes	1,970	.4
Lemonex-Rock outcrop complex, 3 to 45 percent slopes	13,220	2.9
Lickskillet-Rock outcrop complex, 20 to 70 percent slopes	18,170	3.9
Logdell very shaly loam, 45 to 70 percent north slopes	1,810	.4
McGarr stony loam, 5 to 45 percent slopes	13,670	3.0
McGarr stony loam, 45 to 75 percent slopes	2,780	.6
McGarr-Anatone complex, 5 to 65 percent slopes	9,330	2.0
Oxbow very stony silty clay loam, 2 to 5 percent slopes	10,310	2.2
Oxwall very stony silty clay loam, 2 to 7 percent slopes	14,540	2.1
Oxwall extremely stony silty clay loam, 2 to 7 percent slopes	12,060	2.6
Piersonte-Logdell-Laycock complex, 45 to 70 percent north slopes	3,590	.8
Powder silt loam, occasional overflow	620	.1
Ricco silty clay loam	2,700	.6
Rock outcrop-Lemonex complex, 30 to 75 percent slopes	3,520	.8
Rockly extremely stony loam, 2 to 20 percent slopes	6,190	1.0
Ruddley loam, 5 to 40 percent slopes	1,920	.4
Ruddley-Rock outcrop complex, 5 to 40 percent slopes	6,360	1.4
Simas clay loam, 8 to 30 percent south slopes	23,530	5.1
Simas very stony clay loam, 8 to 40 percent south slopes	50,010	10.9
Simas-Day complex, 5 to 40 percent slopes	8,860	1.9
Simas-Badland association, very steep	8,680	1.9
Simas-Tub association, steep	6,510	1.4
Snell very stony loam, 15 to 40 percent north slopes	1,800	.4
Snell-Anatone complex, 15 to 40 percent north slopes	6,490	1.4
Snell-Anatone complex, 40 to 70 percent north slopes	5,120	1.1
Top silt loam, 15 to 35 percent slopes	4,380	.9
Top silt loam, 35 to 65 percent slopes	1,510	.3
Tub clay loam, 20 to 40 percent north slopes	9,890	2.1
Tub clay loam, 40 to 65 percent north slopes	1,930	.4
Tub stony clay loam, 3 to 20 percent slopes	4,750	1.0
Ukiah stony silty clay loam, 2 to 8 percent slopes	500	.1
Ukiah very stony silty clay loam, 3 to 15 percent slopes	1,670	.4
Ukiah extremely stony silty clay loam, 15 to 50 percent slopes	10,410	2.3
Veazie loam	6,920	1.5
Venator very shaly loam, 5 to 40 percent slopes	1,670	.4
Venator-Rock outcrop complex, 40 to 65 percent slopes	5,770	1.2
Waterbury extremely stony silty clay loam, 3 to 40 percent slopes	47,670	10.3
Wrightman-Anatone complex, 2 to 20 percent slopes	2,740	.6
Total	462,500	100.0

ponderosa pine, juniper, mountainmahogany, Idaho fescue, and bluebunch wheatgrass. The average annual precipitation is 17 to 24 inches, the average annual air temperature is 40° to 45° F, and the frost free period is 30 to 90 days.

In a representative profile the surface layer is very dark grayish brown gravelly loam about 5 inches thick. The upper 5 inches of the subsoil is very dark grayish brown clay loam, and the lower 6 inches is dark brown gravelly clay. Depth to bedrock is about 16 inches. The soil is neutral throughout its profile.

Permeability is slow, available water capacity is 1 inch to 3 inches, and the water supplying capacity is 8 to 10 inches. Effective rooting depth is 10 to 20 inches.

These soils are used for timber, grazing, and wildlife habitat.

Representative profile of Alding very gravelly loam in an area of Alding-Rock outcrop complex, 30 to 70 percent slopes, about 50 feet east of road in the SW¼-NE¼ section 12, T. 14 S., R. 32 E.:

A1—0 to 5 inches; very dark grayish brown (10YR

3/2) gravelly loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; slightly hard, friable, slightly sticky, slightly plastic; many very fine roots; 30 percent pebbles; neutral (pH 6.8); clear smooth boundary; 2 to 8 inches thick.

B1—5 to 10 inches; very dark grayish brown (10YR 3/2) clay loam, dark grayish brown (10YR 4/2) dry; moderate very fine subangular blocky structure; slightly hard, friable, sticky, plastic; many very fine roots; many very fine tubular pores; few thin clay films; 15 percent 2-millimeter to ¾-inch pebbles; neutral (pH 7.0); clear smooth boundary; 2 to 8 inches thick.

B2t—10 to 16 inches; dark brown (10YR 3/3) gravelly clay, brown (10YR 4/3) dry; weak medium subangular blocky structure; hard, firm, very sticky, very plastic; many very fine roots; many very fine tubular pores; common thin clay films; 25 percent pebbles; neutral (pH 7.0); clear smooth boundary; 4 to 8 inches thick.

R—16 inches; fractured metavolcanic bedrock.

Depth to bedrock ranges from 10 to 20 inches. The material in the profile is 20 to 35 percent rock fragments that are mostly pebbles. In the A1 horizon, value is 2 or 3 moist and 4 or 5 dry. In the B2t horizon, value is 3 or 4 moist and 4 or 5 dry.

1F—Alding-Rock outcrop complex, 30 to 70 percent slopes. This complex is about 50 percent Alding gravelly loam, 20 percent Rock outcrop, and 15 percent Lithic Xerochrepts, which are very gravelly clays or very gravelly clay loams about 3 to 15 inches deep to bedrock. It generally has south facing slopes. Rock outcrop and Lithic Xerochrepts are near ridgetops, on convex slopes, and in narrow bands at right angles to the slope. The Alding soil is between and around the Rock outcrop and Lithic Xerochrepts. It has the profile described as representative of the Alding series.

Included with this complex in mapping are areas of gravelly soils 20 to 40 inches deep and Ruddley soils. These areas make up about 15 percent of the mapping unit.

Runoff is rapid, and the hazard of erosion is high. Capability unit VIIs. The Alding soil is in woodland group 5d1 and wildlife group 5. The Rock outcrop is not placed in a woodland group, range site, or wildlife group. Lithic Xerochrepts are in Mahogany Rockland range site and wildlife group 5.

Anatone Series

The Anatone series consists of well drained soils that formed in loess and residuum weathered from basalt on uplands. Slopes are 2 to 70 percent. Elevation is 3,000 to 5,500 feet. The vegetation is Sandberg bluegrass, bluebunch wheatgrass, low sagebrush, and forbs. The average annual precipitation is 17 to 28 inches, the average annual air temperature is 42° to 45° F, and the frost free period is 10 to 60 days.

In a representative profile the surface layer is dark reddish brown extremely stony loam about 3 inches thick. The subsoil is dark reddish brown very cobbly loam about 8 inches thick. Basalt bedrock is at a depth of about 11 inches. The soil is neutral throughout its profile.

Permeability is moderate, available water capacity is 0.5 inch to 1.8 inches, and the water supplying capacity is 3 to 5 inches. Effective rooting depth is 10 to 20 inches.

These soils are used for range and wildlife habitat.

Representative profile of Anatone extremely stony loam in an area of McGarr-Anatone complex, 5 to 65 percent slopes, near the center of SE¼ section 8, T. 11 S., R. 27 E.:

A1—0 to 3 inches; dark reddish brown (5YR 2/3) extremely stony loam, reddish brown (5YR 5/3) dry; moderate fine granular structure; slightly hard, very friable; slightly sticky and slightly plastic; common fine and very fine roots; many fine irregular pores; 5 percent pebbles, 10 percent cobbles, 10 percent stones; neutral (pH 6.6); clear smooth boundary; 2 to 5 inches thick.

B2—3 to 11 inches; dark reddish brown (5YR 2/3) very cobbly loam, reddish brown (5YR 5/3) dry; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; many fine irregular pores; 30 percent pebbles, 40 percent cobbles, few stones; neutral (pH 6.6); abrupt wavy boundary; 7 to 17 inches thick.

R—11 inches; basalt bedrock.

Depth to basalt bedrock ranges from 10 to 20 inches. In the A and B horizons, value is 2 or 3 moist and 3 to 5 dry; chroma is 2 or 3 moist; and hue is 7.5YR, 5YR, or 2.5YR. The content of rock fragments ranges from 25 to 75 percent. The A horizon is extremely stony loam, very stony loam, or very cobbly loam.

2D—Anatone-Wrightman complex, 3 to 25 percent slopes. This complex is about 50 percent Anatone extremely stony loam, 3 to 25 percent slopes, and about 35 percent Wrightman loam, 3 to 25 percent slopes. It is on gently sloping upland plateaus and on adjoining side slopes. The Anatone soil is in areas of scabland near ridgetops and on concave slopes between and around areas of Wrightman soils. The Wrightman soil is in irregularly shaped, 3- to 5-acre areas on slightly convex slopes. The Wrightman soil has the profile described as representative of the Wrightman series.

Included with this complex in mapping are areas of McGarr soils, Rock outcrop, and very shallow very stony soils. These areas make up as much as 15 percent of the mapping unit.

Runoff is slow to medium, and the hazard of erosion is moderate to high. Capability unit VIIs. The Anatone soil is in Scabland range site and wildlife group 4. The Wrightman soil is in Shrubby Rolling Hills range site and wildlife group 4.

Badland

Badland consists of very steep nearly barren land

broken by numerous intermittent drainage channels. It has no farming value. It is mapped only with Simas soils.

Balder Series

The Balder series consists of well drained soils that formed in colluvium weathered from volcanic tuff. Slopes are 5 to 55 percent. Elevation is 3,000 to 4,200 feet. The vegetation is bluebunch wheatgrass, Sandberg bluegrass, and juniper. The average annual precipitation is 14 to 18 inches, the average annual air temperature is 45° to 48° F, and the average frost free period is 90 to 110 days.

In a representative profile the surface layer is very dark grayish brown stony loam about 9 inches thick. The subsoil is dark yellowish brown loam about 7 inches thick. Depth to the volcanic tuff is about 16 inches.

Permeability is moderate, available water capacity is 1 inch to 3.5 inches, and the water supplying capacity is 6 to 8 inches. Effective rooting depth is 10 to 20 inches.

These soils are used for range and wildlife habitat.

Representative profile of Balder stony loam, 5 to 15 percent slopes, about 6 miles east and 2 miles north of John Day, 880 feet south of the center of section 11, T. 13 S., R. 32 E.:

A11—0 to 3 inches; very dark grayish brown (10YR 3/2) stony loam, grayish brown (10YR 5/2) dry; weak thin platy structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; many very fine irregular pores; 5 percent pebbles; neutral (pH 6.6); abrupt smooth boundary; 2 to 4 inches thick.

A12—3 to 9 inches; dark brown (10YR 3/3) loam, grayish brown (10YR 5/2) dry; weak coarse prismatic structure; slightly hard, very friable; slightly sticky and slightly plastic; few very fine roots; many very fine tubular pores; 5 percent pebbles; neutral (pH 6.6); clear smooth boundary; 3 to 8 inches thick.

B2—9 to 16 inches; dark yellowish brown (10YR 3/4) loam, brown (10YR 5/3) dry; weak coarse prismatic and moderate medium subangular blocky structure; hard, firm, sticky and plastic; few very fine roots; many very fine tubular pores; 10 percent pebbles; neutral (pH 6.8); abrupt smooth boundary; 3 to 10 inches thick.

IICr—16 inches; light gray to very pale brown volcanic tuff, lime coatings on the surface; semiconsolidated; can be chipped with spade with difficulty.

Depth to bedrock ranges from 10 to 20 inches. The content of rock fragments in the profile ranges from 5 to 35 percent. In the A1 horizon value is 2 or 3 moist and 4 or 5 dry, and chroma is 2 or 3 moist or dry. In the B2 horizon value is 2 or 3 moist and 4 or 5 dry, and chroma of 3 or 4 moist and dry.

3C—Balder stony loam, 5 to 15 percent slopes. This soil is on uplands. It has the profile described as representative of the series. Areas range from 100 to about 300 acres in size.

Included with this soil in mapping are areas of silt loam soils 20 to 40 inches deep, very stony soils 5 to 10 inches deep, and Rock outcrop. These areas make up as much as 15 percent of the mapping unit.

Runoff is medium, and the hazard of erosion is moderate. Capability unit VIe; Rolling Hills range site; wildlife group 4.

4F—Balder very stony loam, 15 to 55 percent slopes. This soil is on uplands. It generally has south facing slopes. It has a profile similar to the one described as representative of the series. Areas range from 100 surface layer. Areas range from 100 to about 400 acres in size.

Included with this soil in mapping are areas of silt loam soils 20 to 40 inches deep, very stony soils 5 to 10 inches deep, and Rock outcrop. These areas make up as much as 15 percent of the mapping unit.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. Capability unit VIIs; South Exposure range site; wildlife group 4.

Boyce Series

The Boyce series consists of poorly drained soils that formed in stratified alluvium on bottom lands. Slopes are 0 to 2 percent. Elevation is 2,200 to 4,000 feet. The vegetation is sedges, rushes, and tufted hairgrass. The average annual precipitation is 12 to 16 inches, the average annual air temperature is 45° to 52° F, and the frost free period is 100 to 150 days.

In a representative profile the surface layer is black silty clay loam about 20 inches thick. The next layer is very dark gray silty clay loam about 8 inches thick. The substratum is very dark gray loam and loamy sand to a depth of 42 inches. The lower part of the substratum is very gravelly sand. The surface layer is moderately alkaline, and the next layer and the substratum is mildly alkaline. The surface layer is weakly calcareous.

Permeability is moderate, and available water capacity is 5 to 8 inches. Effective rooting depth is 24 to 40 inches.

These soils are used for irrigated hay and pasture and for wildlife habitat.

Representative profile of Boyce silty clay loam, about 5 miles east of Dayville, 50 feet south and 250 feet east of junction of ranch road and Oregon Highway 26 in the NE¼NW¼ section 11, T. 13 S., R. 27 E.:

Ap—0 to 6 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate fine granular structure; slightly hard, friable, slightly sticky, slightly plastic; many very fine roots; common very fine tubular pores; weakly calcareous; moderately alkaline (pH 8.0); clear smooth boundary; 4 to 8 inches thick.

A12—6 to 12 inches; black (10YR 2/1) silty clay loam, gray (10YR 5/1) dry; common fine distinct reddish brown mottles; moderate fine subangular blocky structure; slightly hard, friable, sticky, plastic; many very fine roots; many very fine tubular pores; moderately alkaline (pH

8.0); clear smooth boundary; 4 to 8 inches thick.

A13—12 to 20 inches; black (10YR 2/1) silty clay loam, gray (10YR 5/1) dry; many coarse distinct reddish brown mottles; weak medium and fine subangular blocky structure; hard, firm, sticky, plastic; common very fine roots; many very fine tubular pores; moderately alkaline (pH 8.0); clear smooth boundary; 8 to 12 inches thick.

AC—20 to 28 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; many coarse prominent reddish brown mottles; massive; hard, firm, sticky, plastic; common very fine roots; many very fine and few medium pores; mildly alkaline (pH 7.8); clear smooth boundary; 5 to 10 inches thick.

IIC1—28 to 31 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; massive; slightly hard, very friable, slightly sticky, slightly plastic; common very fine roots; few very fine pores; mildly alkaline (pH 7.6); abrupt smooth boundary; 0 to 5 inches thick.

IIIC2—31 to 42 inches; very dark gray (N 3/0) loamy sand, gray (N 5/0) dry; structureless, single grained; loose; few roots; few fine and medium pores; mildly alkaline (pH 7.4); abrupt smooth boundary; 0 to 20 inches thick.

IVC3—42 to 60 inches; stratified very gravelly sand and sand; single grained; loose.

Depth to very gravelly sand or sand is 20 to 40 inches. The A horizon is weakly calcareous in the upper part in some places, but the rest of the profile is noncalcareous. The A horizon ranges from loam to silty clay loam. Distinct mottles are at a depth of 10 to 24 inches. The A horizon is black or very dark gray when moist and gray or dark gray when dry.

5—Boyce silty clay loam. This soil is on bottom lands. Slopes are 0 to 2 percent. Areas range from 10 to about 100 acres in size.

Included with this soil in mapping are areas of Dayville, Veazie, Ricco, and very gravelly soils. These areas make up as much as 15 percent of the mapping unit.

Runoff is very slow, and the hazard of erosion is slight. Occasional flooding occurs in winter or early in spring. Capability unit IVw–1 irrigated; not placed in a range site; wildlife group 1.

Courtrock Series

The Courtrock series consists of well drained soils that formed in mixed alluvium on alluvial fans. Slopes are 2 to 7 percent. Elevation is 2,100 to 3,400 feet. In uncultivated areas, the vegetation is bunchgrasses, forbs, shrubs, and juniper. The average annual precipitation is 10 to 13 inches, the average annual air temperature is 49° to 51° F, and the frost free period is 110 to 150 days.

In a representative profile the surface layer is very dark grayish brown loam about 7 inches thick. The next layer is very dark grayish brown loam about 18 inches thick and very dark grayish brown gravelly loam about 8 inches thick. The substratum is calcareous, very dark grayish brown loam 17 inches or more thick. The profile is neutral or mildly alkaline in the upper part and mildly alkaline to moderately alkaline in the substratum.

Permeability is moderately rapid, available water capacity is 6 to 9 inches, and the water supplying capacity is 8 to 11 inches. Effective rooting depth is more than 40 inches.

These soils are used for irrigated crops, mainly alfalfa or alfalfa and grass hay; pasture; some wheat and barley; and wildlife habitat.

Representative profile of Courtrock loam, 2 to 7 percent slopes, 175 yards north of bridge on Oregon Highway 19, in roadcut in the SW¼NE¼ section 30, T. 11 S., R. 26 E.:

A1—0 to 7 inches; very dark grayish brown (10YR 3/2) loam, brown (10YR 4/3) dry; weak fine granular structure; soft, very friable, slightly sticky and nonplastic; many fine and very fine roots; many very fine irregular pores; 10 percent pebbles; neutral (pH 7.0); clear smooth boundary; 5 to 9 inches thick.

AC1—7 to 25 inches; very dark grayish brown (10YR 3/2) loam, brown (10YR 4/3) dry; weak coarse subangular blocky structure; slightly hard, very friable, slightly sticky and nonplastic; many fine and very fine roots; many very fine irregular pores; 15 percent pebbles; neutral (pH 7.2); abrupt wavy boundary; 8 to 24 inches thick.

AC2—25 to 33 inches; very dark grayish brown (10 YR 3/2) gravelly loam, brown (10YR 4/3) dry; massive; slightly hard, very friable, slightly sticky and nonplastic; common fine roots; 25 percent fine pebbles; lime coatings on pebbles, noncalcareous matrix; mildly alkaline (pH 7.6); gradual wavy boundary; 5 to 18 inches thick.

C1ca—33 to 42 inches; very dark grayish brown (10YR 3/2) loam, brown (10YR 4/3) dry; massive; slightly hard, very friable, slightly sticky and nonplastic; common fine roots; many very fine continuous pores; 15 percent fine pebbles; weakly calcareous and lime in a few filaments; mildly alkaline (pH 7.6); gradual wavy boundary; 5 to 18 inches thick.

C2ca—42 to 50 inches; very dark grayish brown (10YR 3/2) loam, brown (10YR 4/3) dry; massive; slightly hard, very friable, slightly sticky and nonplastic; many very fine continuous pores; 15 percent fine pebbles; strongly effervescent with segregated lime; moderately alkaline (pH 8.2).

Depth to very gravelly sand is 40 to more than 60 inches. Between depths of 10 to 40 inches, the soil is loam or heavy sandy loam and is less than 18 percent clay. The content of rock fragments ranges from 0 to

25 percent in the upper part and 15 to 35 percent in the lower part. Depth to secondary lime is 28 to 40 inches. In the A horizon value is 4 or 5 dry, and chroma is 2 or 3 moist or dry.

6B—Courtrock loam, 2 to 7 percent slopes. This soil is on alluvial fans. Areas range from 15 to about 200 acres in size.

Included with this soil in mapping are areas of Hack soils, very gravelly soils, and soils shallow to sand and gravel. These areas make up as much as 15 percent of the mapping unit.

Runoff is slow, and the hazard of erosion is slight. Capability unit IIe–1 irrigated and IVc–1 dryland; not placed in a range site; wildlife group 2.

Daxty Series

The Daxty series consists of well drained soils that formed in colluvium weathered from volcanic tuff on uplands. Slopes are 3 to 40 percent. Elevation is 4,200 to 5,500 feet. The vegetation is ponderosa pine, Douglas-fir, Idaho fescue, bluebunch wheatgrass, elk sedge, and forbs. The average annual precipitation is 17 to 24 inches, the average annual air temperature is 40° to 45° F, and the frost free period is 20 to 60 days.

In a representative profile the upper 4 inches of the surface layer is very dark brown loam, and the lower 3 inches is very dark grayish brown flaggy loam. The subsoil is brown very flaggy loam about 19 inches thick. Platy tuff bedrock is at a depth of about 26 inches. The soil is slightly acid throughout its profile.

Permeability is moderate, available water capacity is 2 to 5 inches, and the water supplying capacity is 9 to 11 inches. Effective rooting depth is 20 to 40 inches.

These soils are used for timber, grazing, and wildlife habitat.

Representative profile of Daxty loam, 15 to 40 percent north slopes, south of road in the NW¼SE¼ section 25, T. 12 S., R. 31 E.:

O1—1 inch to 0, fir and pine needles and twigs.

A1—0 to 4 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; moderate very fine granular structure; loose, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; 10 percent flagstones; slightly acid (pH 6.4); clear smooth boundary; 2 to 8 inches thick.

A3—4 to 7 inches; very dark grayish brown (10YR 3/2) flaggy loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many fine and very fine continuous pores; 25 percent flagstones; slightly acid (pH 6.4); clear wavy boundary; 0 to 8 inches thick.

B2—7 to 26 inches; brown (10YR 4/3) very flaggy loam, light brownish gray (10YR 6/2) dry; weak very fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; many fine and very fine continuous pores; 75 percent flagstones; slightly acid (pH 6.4); abrupt smooth boundary; 10 to 25 inches thick.

R—26 inches; platy tuff bedrock.

Depth to the tuff ranges from 20 to 40 inches. Between a depth of 10 inches and the volcanic tuff, the soil is sandy loam to light loam. The content of coarse fragments ranges from 35 to 75 percent. In the A horizon value is 2 or 3 moist and 4 or 5 dry, and chroma is 2 or 3. In the B horizon value is 3 or 4 moist and 6 dry, and chroma is 2 or 3.

7E—Daxty loam, 15 to 40 percent north slopes. This soil is on uplands. It has the profile described as representative of the series. Areas range from 100 to about 1,000 acres in size.

Included with this soil in mapping are areas of Rock outcrop, shallow very flaggy soils, and very flaggy soils more than 40 inches thick. These areas make up as much as 15 percent of the mapping unit.

Runoff is moderate to rapid, and the hazard of erosion is moderate to high. Capability unit VIs; woodland group 3f1; wildlife group 5.

8E—Daxty-Rock outcrop complex, 3 to 40 percent slopes. This complex is about 55 percent Daxty very flaggy loam, about 20 percent Rock outcrop, and about 15 percent Lithic Xerochrepts, which are flaggy or very flaggy loams or clay loams 3 to 15 inches deep to bedrock. It has south facing slopes. The Daxty soil is mainly on the lower and middle parts of slopes. It has a profile similar to the one described as representative of the Daxty series, but the surface is very flaggy. Rock outcrop and Lithic Xerochrepts are mainly in narrow ridgetops and the upper parts of slopes.

Included with this complex in mapping are areas of loamy soils that are 50 to 70 percent rock fragments and are 40 to 60 inches deep. Also included are soils that are 5 to 35 percent rock fragments and 20 to 40 inches deep. These areas make up about 10 percent of the mapping unit.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. Capability unit VIIs. The Daxty soil is in woodland group 4f1 and wildlife group 5. Rock outcrop is not placed in a woodland group, range site, or wildlife group. Lithic Xerochrepts are in Mahogany Rockland range site and wildlife group 5.

Day Series

The Day series consists of well drained soils that formed in clayey sediment. Slopes are 5 to 40 percent. Elevation is 2,100 to 4,000 feet. The vegetation is bluebunch wheatgrass, forbs, and shrubs. The average annual precipitation is 10 to 14 inches, the average annual air temperature is 45° to 50° F, and the frost free period is 90 to 150 days.

In a representative profile the surface layer is dark red clay about 2 inches thick. The substratum is dark red or dark reddish brown calcareous clay about 40 inches or more thick.

Permeability is very slow, available water capacity is 6 to 10 inches, and the water supplying capacity is 6 to 8 inches. Effective rooting depth is 40 to 60 inches.

These soils are used for range and wildlife habitat.

Day soils are mapped only with Simas soils. For a description of the mapping unit, see the Simas series.

Representative profile of Day clay in an area of Simas-Day complex, 5 to 40 percent slopes, 100 feet east of Oregon Highway 26 in the SW¼SW¼SW¼ section 17, T. 11 S., R. 26 E.:

A1—0 to 2 inches; dark red (2.5YR 3/6) clay, dark reddish brown (2.5YR 3/4) dry; strong very fine granular structure; individual granules are hard, firm, very sticky and very plastic; many fine and very fine roots; many very fine irregular pores; 5 percent fine pebbles; few cobbles; moderately alkaline (pH 8.2); abrupt smooth boundary; 2 to 4 inches thick.

AC1—2 to 10 inches; dark red (2.5YR 3/6) clay, dark reddish brown (2.5YR 3/4) dry; moderate fine and medium subangular blocky structure; very hard, very firm, very sticky and very plastic; many very fine and fine roots; many very fine irregular pores; 5 percent pebbles; few cobbles; slightly calcareous with disseminated lime; moderately alkaline (pH 8.4); clear smooth boundary; 6 to 20 inches thick.

AC2ca—10 to 24 inches; dark reddish brown (2.5YR 3/4) clay, dark reddish brown (2.5YR 3/4) dry; weak coarse and medium prismatic structure parting to strong medium and fine blocky or wedge shaped; extremely hard, very firm, very sticky and very plastic; few fine and very fine roots; common very fine tubular pores; many intersecting slickensides; 5 percent fine pebbles; calcareous with disseminated lime; moderately alkaline (pH 8.4); gradual wavy boundary; 8 to 15 inches thick.

Cca—24 to 43 inches; dark red (2.5YR 3/6) clay, red (2.5YR 4/5) dry; weak medium and fine angular wedge shaped and blocky structure; extremely hard, very firm, very sticky and very plastic; very few fine roots; common fine tubular pores; many intersecting slickensides; calcareous with disseminated lime and lime in threads; moderately alkaline (pH 8.4).

Depth to weathered sediment is 40 to 60 inches. Between depths of 10 and 40 inches the soil is 60 to 70 percent clay. Rock fragments range from 0 to 15 percent throughout. Hue is generally 2.5YR, but dark yellowish brown, olive brown, or olive is in the range if the color is derived from the parent sediment. In the A horizon value is 3 or 4 dry, and chroma is 2 to 6 moist or dry. Structure is strong fine or very fine granular. In the AC and C horizons, value is 3 or 4 dry, and chroma is 3 to 6 moist or dry.

Dayville Series

The Dayville series consists of somewhat poorly drained soils that formed in recent alluvium on bottom lands and low alluvial fans. Slopes are 0 to 2 percent. Elevation is 2,200 to about 4,000 feet. In uncultivated areas the vegetation is sedges, rushes, Kentucky bluegrass, and willows. The average annual precipitation is 12 to 16 inches, the average annual air temperature is 48° to 51° F, and the frost free period is 100 to 150 days.

In a representative profile the surface layer is very dark brown silt loam about 11 inches thick. The upper part of the substratum is very dark grayish brown silt loam about 25 inches thick. The lower part is stratified sand and very gravelly sand to a depth of 60 inches or more. The soil is moderately alkaline throughout its profile. It is calcareous to a depth of about 18 inches.

Permeability is moderate, and available water capacity is 5 to 9 inches. Effective rooting depth is 30 to 36 inches.

These soils are used for irrigated hay and pasture and for wildlife habitat.

Representative profile of Dayville silt loam, about 5 miles east of Dayville in the NE¼SE¼NW¼ section 11, T. 13 S., R. 2, E.:

Ap—0 to 5 inches; very dark brown (10YR 2/2) silt loam, grayish brown (10YR 5/2) dry; weak thin and medium platy and moderate fine subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; many very fine roots; very few fine continuous tubular pores; weakly calcareous; moderately alkaline (pH 8.0); clear smooth boundary; 4 to 6 inches thick.

A12—5 to 11 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine and medium blocky structure; slightly hard, friable, slightly sticky, slightly plastic; many very fine roots; few medium and few coarse and many very fine tubular pores; weakly calcareous; moderately alkaline (pH 8.0); clear smooth boundary; 4 to 10 inches thick.

AC—11 to 18 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; common very fine roots; very few fine tubular pores; flecks of lime, matrix not calcareous; moderately alkaline (pH 8.0); gradual smooth boundary; 5 to 10 inches thick.

C1—18 to 27 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; massive; slightly hard, friable, slightly sticky, slightly plastic; few very fine roots; common fine and very fine tubular pores; moderately alkaline (pH 8.0); noncalcareous; gradual smooth boundary; 0 to 10 inches thick.

C2—27 to 33 inches; very dark grayish brown (10YR 3/2) heavy silt loam, grayish brown (10YR 5/2) dry; common fine distinct dark brown (7.5YR 4/4) mottles; massive; slightly hard, friable, slightly sticky, slightly plastic; few roots; few very fine and fine tubular pores; non-

calcareous; moderately alkaline (pH 8.0); clear smooth boundary; 4 to 7 inches thick.

C3—33 to 36 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; many medium distinct dark brown (7.5YR 4/4) mottles; massive; slightly hard, friable, slightly sticky, slightly plastic; few very fine pores; noncalcareous; moderately alkaline (pH 8.0); abrupt smooth boundary; 2 to 6 inches thick.

IIC4—36 to 60 inches; stratified sand and very gravelly sand; single grained; loose.

Depth to bedrock is more than 60 inches. Depth to stratified sand and very gravelly sand ranges from 15 to 40 inches. Between a depth of 10 inches and the stratified horizon of sand and very gravelly sand, the material is silt loam or light silty clay loam that, in places, has thin layers of loam or sandy loam. Depth to distinct or prominent mottles is 24 to 36 inches. The soil is calcareous in the A horizon but is noncalcareous in some parts between depths of 10 and 20 inches. In the A horizon value is 2 or 3 moist and 4 or 5 dry.

9—Dayville silt loam. This soil is on bottom lands. Slopes are 0 to 2 percent. Areas range from 10 to about 100 acres in size.

Included with this soil in mapping are areas of Veazie, Boyce, and Ricco soils. These areas make up as much as 15 percent of the mapping unit.

Runoff is slow, and the hazard of erosion is moderate. Occasional flooding occurs in winter or early in spring. Capability unit IIw–1 irrigated; not placed in a range site; wildlife group 2.

Dumps

10—Dumps. Dumps consist of tailings from gold dredging. They are mainly on bottom land. They consist mainly of rounded and subrounded stones, cobbles, and pebbles in large alternating parallel ridges and troughs. The elevation at the top of the ridge is generally 15 to 20 feet above that of the bottom of the trough. The tops of the ridges are about 100 feet apart and 200 to about 1,500 feet long. The troughs are generally partly filled with water. Willows and cottonwoods grow in places near the water edge. Most of the fine material was washed away during dredging. In a few places an occasional ridge is soil material.

This miscellaneous area is used mainly for wildlife habitat. Some areas have been smoothed and are used for building sites. Capability unit VIIIs; not placed in a range site; wildlife group 2.

Fopiano Series

The Fopiano series consists of well drained soils that formed in colluvium and residuum weathered from old sediment and tuff on uplands. Slopes are 2 to 40 percent. Elevation is 3,800 to 5,000 feet. The vegetation is Idaho fescue, bluebunch wheatgrass, Sandberg bluegrass, and low sagebrush. The average annual precipitation is 13 to 16 inches, the average annual air temperature is about 43° F, and the frost free period is 20 to 60 days.

In a representative profile the surface layer is black silty clay loam about 5 inches thick. The subsoil is very dark brown and dark grayish brown clay about 10 inches thick. Depth to partly consolidated volcanic tuff is about 15 inches.

Permeability is slow, available water capacity is 2 to 3 inches, and the water supplying capacity is 8 to 10 inches. Effective rooting depth is 10 to 20 inches.

These soils are used for range and wildlife habitat.

Representative profile of Fopiano silty clay loam, 2 to 15 percent slopes, east of road in the SW¼NW¼ section 3, T. 12 S., R. 26 E.:

A1—0 to 5 inches; black (10YR 2/1) silty clay loam, gray (10YR 5/1) dry; moderate medium platy and weak fine granular structure; slightly hard, friable, sticky and plastic; many very fine and fine roots; many very fine irregular pores; neutral (pH 6.6); abrupt smooth boundary; 4 to 10 inches thick.

B21t—5 to 11 inches; very dark brown (10YR 2/2) clay, dark gray (10YR 4/1) dry; strong medium prismatic structure parting to moderate medium blocky; very hard, firm, sticky and plastic; common very fine and fine roots; many very fine continuous pores; continuous pressure faces; neutral (pH 6.6); clear wavy boundary; 3 to 7 inches thick.

B22t—11 to 15 inches; very dark grayish brown (10YR 3/2) clay, dark grayish brown (10YR 4/2) dry; moderate medium subangular blocky structure; very hard, firm, very sticky and very plastic; common very fine and fine roots; many very fine continuous pores; common moderately thick clay films; common pressure faces; 25 percent soft angular pebbles; neutral (pH 6.8); abrupt smooth boundary; 2 to 5 inches thick.

Cr—15 inches; partly consolidated rhyolitic tuff.

Depth to the partly consolidated volcanic tuff is 10 to 20 inches. The content of coarse fragments ranges from 0 to 25 percent throughout the profile. Colors throughout range in hue from 10YR to 7.5YR. In the A1 horizon value is 4 or 5 dry and chroma is 1 or 2. In the B2t horizon value is 2 or 3 moist and chroma is 2 or 3.

11C—Fopiano silty clay loam, 2 to 15 percent slopes. This soil is on undulating uplands. It has the profile described as representative of the series. Areas range from 100 to about 500 acres in size.

Included with this soil in mapping are areas of Waterbury soils, Gwin soils, and very shallow soils. These areas make up as much as 15 percent of the mapping unit. The Waterbury and Gwin soils are on short, generally south facing slopes.

Runoff is medium, and the hazard of erosion is moderate. Capability unit VIe; Clayey Terrace range site; wildlife group 4.

11E—Fopiano silty clay loam, 15 to 40 percent north slopes. This soil is on uplands. Areas range from 100 to about 500 acres in size.

Included with this soil in mapping are areas of Snell and Anatone soils. These areas make up as much as 15 percent of the mapping unit.

Runoff is rapid, and the hazard of erosion is high. Capability unit VIe; North Exposure range site; wildlife group 4.

Grell Series

The Grell series consists of well drained soils that formed in colluvium and residuum weathered mainly from serpentine bedrock on uplands. Slopes are 7 to 40 percent. Elevation is 3,000 to 5,000 feet. The vegetation is bluebunch wheatgrass, Sandberg bluegrass, and juniper. The average annual precipitation is 13 to 18 inches, the average annual air temperature is 45° to 50° F, and the frost free period is 90 to 120 days.

In a representative profile the surface layer is black and very dark brown very gravelly loam about 9 inches thick. The subsoil is dark brown very gravelly loam about 8 inches thick. Depth to serpentine bedrock is about 17 inches. The soil is neutral throughout its profile.

Permeability is moderate, available water capacity is 0.5 to 2.5 inches, and the water supplying capacity is 6 to 8 inches. Effective rooting depth is 10 to 20 inches.

These soils are used for range and wildlife habitat.

Representative profile of Grell very gravelly loam, 15 to 40 percent north slopes, 3 miles southwest of John Day in the SE¼NW¼ section 3, T. 14 S., R. 31 E.:

A11—0 to 3 inches; black (10YR 2/1) very gravelly loam, dark gray (10YR 4/1) dry; moderate very fine granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; 40 percent pebbles, 10 percent cobbles; neutral (pH 6.8); clear smooth boundary; 2 to 4 inches thick.

A12—3 to 9 inches; very dark brown (10YR 2/2) very gravelly loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; many very fine continuous pores; 40 percent pebbles, 10 percent cobbles; neutral (pH 6.8); clear smooth boundary; 3 to 11 inches thick.

B2—9 to 17 inches; dark brown (10YR 3/3) very gravelly loam, brown (10YR 4/3) dry; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine continuous pores; 50 percent angular pebbles and 10 percent cobbles; neutral (pH 6.8); abrupt wavy boundary; 4 to 12 inches thick.

R—17 inches; fractured serpentine bedrock, fractures 4 to 10 inches apart.

Depth to bedrock is 10 to 20 inches. The content of rock fragments in the profile ranges from 35 to 75 percent. In the A1 horizon value is 4 or 5 dry and 2 or 3 moist. In the B2 horizon chroma is 3 or 4 moist or dry.

12E—Grell very gravelly loam, 7 to 40 percent south slopes. This soil is on uplands. Areas range from 100 to about 400 acres in size.

Included with this soil in mapping are areas of Simas soils, Gwin soils, and Rock outcrop. These areas make up as much as 15 percent of the mapping unit.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. Capability unit VIIs; South Exposure range site; wildlife group 4.

13E—Grell very gravelly loam, 15 to 40 percent north slopes. This soil is on uplands. It has the profile described as representative of the series. Areas range from 100 to about 300 acres in size.

Included with this soil in mapping are areas of Tub soils, Snell soils, and Rock outcrop. These areas make up as much as 15 percent of the mapping unit.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. Capability unit VIIs; Droughty North Exposure range site; wildlife group 4.

Gwin Series

The Gwin series consists of well drained soils that formed on uplands in colluvium weathered from basalt and mixed with loess. Slopes are 3 to 70 percent. Elevation is 3,200 to 4,800 feet. The vegetation is bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. The average annual precipitation is 14 to 20 inches, the average annual air temperature is 45° to 49° F, and the frost free period is 90 to 110 days.

In a representative profile the surface layer is very dark brown very stony silt loam about 3 inches thick. The upper 6 inches of the subsoil is very dark brown very cobbly silty clay loam, and the lower 4 inches is dark brown very cobbly silty clay loam. Depth to basalt bedrock is about 13 inches. The soil is neutral throughout its profile.

Permeability is moderately slow, available water capacity is 0.75 to 2.0 inches, and the water supplying capacity is 7 to 14 inches. Effective rooting depth is 10 to 20 inches.

These soils are used for range and wildlife habitat.

Representative profile of Gwin very stony silt loam in an area of Gwin-Rockly complex, 3 to 40 percent slopes, 250 yards east of Franks Creek Road in the SW¼NW¼ section 9, T. 12 S., R. 27 E.:

A1—0 to 3 inches; very dark brown (10YR 2/2) very stony silt loam, brown (10YR 4/3) dry; moderate very fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine roots; many very fine irregular pores; 15 percent pebbles, 25 percent cobbles, 10 percent stones; neutral (pH 6.8); clear smooth boundary; 2 to 6 inches thick.

B1—3 to 9 inches; very dark brown (10YR 2/2) very cobbly silty clay loam, brown (10YR 4/3) dry; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many very fine continuous pores; 20 percent pebbles; 30 percent cobbles; neutral (pH 6.6); clear wavy boundary; 0 to 8 inches thick.

B2—9 to 13 inches; dark brown (10YR 3/3) very

cobbly silty clay loam, brown (10YR 4/3) dry; moderate fine subangular blocky structure; hard, friable, sticky and plastic; common roots; many very fine continuous pores; common thin clay films; 20 percent pebbles, 30 percent cobbles; neutral (pH 6.6); abrupt wavy boundary; 4 to 12 inches thick.

R—13 inches; basalt bedrock.

Depth to basalt bedrock ranges from 10 to 20 inches. The content of rock fragments in the profile ranges from 50 to 80 percent. In the A1 horizon chroma is 1 or 2 moist. In the B2 horizon value is 2 or 3 moist, chroma is 2 or 3 moist or dry, and hue is 7.5YR or 10YR.

14E—Gwin-Rockly complex, 3 to 40 percent slopes. This complex is about 50 percent Gwin very stony silt loam and 30 percent Rockly extremely stony loam. It is on uplands in areas underlain by several different, nearly exposed basalt flows. It has south facing slopes. Each soil is in small, elongated areas roughly at right angles to the slope. The Rockly soil is mainly in areas underlain by the smooth upper surface of the basalt flows, and the Gwin soil is in areas underlain by the eroding edge of the basalt flows. The Gwin soil and the Rockly soil have the profiles described as representative of their respective series.

Included with this complex in mapping are areas of Rock outcrop that make up about 10 percent of the mapping unit. Also included are very stony soils 5 to 10 inches deep and very stony Snell soils, each of which make up about 5 percent of the unit.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. Capability unit VIIs; Gwin soil in South Exposure range site, Rockly soil in Scabland range site; wildlife group 4.

14F—Gwin-Rockly complex, 40 to 70 percent slopes. This complex is about 40 percent Gwin very stony silt loam and about 40 percent Rockly extremely stony loam. It is on uplands in areas underlain by several different, nearly exposed basalt flows. It has south facing slopes. Each soil is in small, elongated areas roughly at right angles to the slope. The Rockly soil is mainly in areas underlain by the smooth upper surface of the basalt flows, and the Gwin soil is in areas underlain by the eroding edge of the basalt flows.

Included with this complex in mapping are areas of Rock outcrop, basalt rims, very stony soils 5 to 10 inches deep, and very stony Snell soils. Each of these make up about 5 percent of the mapping unit.

Runoff is rapid, and the hazard of erosion is high. Capability unit VIIs; Gwin soil in South Exposure range site, Rockly soil in Scabland range site; wildlife group 4.

15F—Gwin-Rock outcrop complex, 40 to 70 percent slopes. This complex is about 45 percent Gwin extremely stony silt loam and about 35 percent Rock outcrop. It is on uplands and is underlain by several different, nearly exposed and exposed basalt flows. It has south facing slopes. The Gwin soil is in small, elongated areas roughly at right angles to the slope. Rock outcrop consists of basalt rims on ridgetops, and on convex or nose-point slopes.

Included with this complex in mapping are areas of Rockly soils, Snell soils, and very stony soils 5 to 10 inches deep. These areas make up as much as 20 percent of the mapping unit.

Runoff is rapid, and the hazard of erosion is high. Capability unit VIIs; Gwin soil in South Exposure range site and wildlife group 4. Rock outcrop not in a range site or wildlife group.

Hack Series

The Hack series consists of well drained soils that formed in mixed alluvium on alluvial fans, terraces, and foot slopes. Slopes are 0 to 20 percent. Elevation is 2,100 to 3,800 feet. In uncultivated areas the vegetation is bunchgrasses, forbs, shrubs, and juniper. The average annual precipitation is 12 to 18 inches, the average annual air temperature is 45° to 51° F, and the frost free period is 100 to 150 days.

In a representative profile the surface layer is very dark grayish brown and dark brown loam about 14 inches thick. The upper 8 inches of the subsoil is brown gravelly clay loam, and the lower 8 inches is calcareous, brown gravelly clay loam. The substratum is calcareous, dark yellowish brown loam 30 inches or more thick. The surface layer and upper part of the subsoil are neutral, and the lower part of the subsoil and the substratum are moderately alkaline.

Permeability is moderately slow, available water capacity is 7 to 11 inches, and the water supplying capacity is 8 to 12 inches. Effective rooting depth is more than 40 inches.

These soils are used mainly for irrigated hay and pasture and for wildlife habitat.

Representative profile of Hack loam, 3 to 7 percent slopes, 2.4 miles west of the town of Mt. Vernon, 100 feet south of U.S. Highway 26, near southwest corner of large turnout in the NW¼SW¼NW¼ section 30, T. 13 S., R. 30 E.:

A11—0 to 3 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate thin platy structure; slightly hard, friable, slightly sticky, slightly plastic; many very fine roots; many very fine pores; 10 percent pebbles; neutral (pH 7.2); clear smooth boundary; 2 to 6 inches thick.

A12—3 to 11 inches; dark brown (10YR 3/3) loam, brown (10YR 5/3) dry; weak medium subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; many very fine roots; many very fine and few medium tubular pores; 10 percent pebbles; neutral (pH 7.0); clear smooth boundary; 5 to 10 inches thick.

A3—11 to 14 inches; dark brown (10YR 3/3) heavy loam, brown (10YR 5/3) dry; weak fine subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; many very fine roots; common very fine and fine tubular pores; 15 percent pebbles; neutral (pH 7.2); clear wavy boundary; 0 to 5 inches thick.

B21t—14 to 22 inches; brown (10YR 4/3) gravelly clay loam, brown (10YR 5/3) dry; moderate fine and very fine sub-

angular blocky structure; slightly hard, friable, sticky, slightly plastic; common fine roots; common very fine and medium tubular pores; common thin clay films; 20 percent pebbles that have white lime coatings; neutral (pH 7.2); clear wavy boundary; 5 to 10 inches thick.

B22tca—22 to 30 inches; brown (10YR 4/3) clay loam, brown (10YR 5/3) dry; moderate fine and very fine subangular blocky structure; slightly hard, friable, sticky, plastic; common fine roots; many very fine and fine tubular pores; common thin and few thick clay films; strongly calcareous, many medium white soft specks of segregated lime; 15 percent pebbles that have white lime coatings; moderately alkaline (pH 8.0); gradual smooth boundary; 5 to 10 inches thick.

Cca—30 to 60 inches; dark yellowish brown (10YR 4/4) loam, brown (10YR 5/3) dry; massive; slightly hard, friable, slightly sticky, slightly plastic; few fine roots; few fine pores; strongly calcareous, common fine white soft specks of segregated lime; 10 percent slightly rounded pebbles; moderately alkaline (pH 8.2).

Depth to bedrock is more than 60 inches. Depth to soft, powdery secondary lime ranges from 20 to 43 inches. Rock fragments in the upper 40 inches of the profile range from 5 to 35 percent. They are mainly semirounded pebbles and a few cobbles. A surface cover of stones and cobbles ranges from 0 to 15 percent. In the A horizon value is 4 or 5 dry and 2 or 3 moist, and chroma is 2 or 3 moist or dry. The clay content in the B horizon ranges from 20 to 30 percent.

16A—Hack loam, 0 to 3 percent slopes. This soil is on low alluvial fans and terraces. Areas range from 15 to about 200 acres in size.

Included with this soil in mapping are areas of Courtrock soils that make up about 15 percent of the mapping unit.

Runoff is slow, and the hazard of erosion is slight. Capability unit IIe–1 irrigated; Bottom land Fan range site; wildlife group 2.

16B—Hack loam, 3 to 7 percent slopes. This soil is on alluvial fans. It has the profile described as representative of the series. Areas range from 15 to about 200 acres in size.

Included with this soil in mapping are areas of very gravelly soils, very stony soils, and soils shallow to sand and gravel. These areas make up as much as 15 percent of the mapping unit.

Runoff is medium, and the hazard of erosion is slight. Capability unit IIe–1 irrigated; Bottom land Fan range site; wildlife group 2.

16C—Hack loam, 7 to 12 percent slopes. This soil is on alluvial fans. Areas range from 15 to about 100 acres in size.

Included with this soil in mapping are areas of very gravelly soils, very stony soils, and soils shallow to sand and gravel. These areas make up as much as 15 percent of the mapping unit.

Runoff is medium, and the hazard of erosion is moderate. Capability unit IIIe–I irrigated and IIIe–2 dryland; Bottom land Fan range site; wildlife group 2.

17C—Hack gravelly loam, 3 to 15 percent slopes. This soil is on alluvial fans and terraces. It has a profile similar to the one described as representative of the series, but the surface layer and subsurface layer are gravelly or very gravelly. Areas range from 15 to about 100 acres in size.

Included with this soil in mapping are areas of very gravelly soils, very stony soils, and soils shallow to sand and gravel. These areas make up as much as 15 percent of the mapping unit.

Runoff is medium, and the hazard of erosion is moderate. Capability unit IVe–1 irrigated; Bottom land Fan range site; wildlife group 2.

18D—Hack extremely stony loam, 3 to 20 percent slopes. This soil is on alluvial fans and terraces. It has a profile that is similar to the one described as representative of the series, but the surface layer is extremely stony and the subsoil is stony or cobbly. Areas range from 15 to about 100 acres in size.

Included with this soil in mapping are areas of Hack loam, Rock outcrop, and extremely stony soils that are 35 to 70 percent rock fragments in the subsoil. These areas make up as much as 15 percent of the mapping unit.

Runoff is medium, and the hazard of erosion is moderate. Capability unit VIIs; Bottom land Fan range site; wildlife group 2.

Hankins Series

The Hankins series consists of well drained soils that formed in old waterlaid sediment on uplands. Slopes are 5 to 45 percent. Elevation is 3,500 to 5,000 feet. The vegetation is ponderosa pine, Douglas-fir, elk sedge, and Idaho fescue. The average annual precipitation is 16 to 25 inches, the average annual air temperature is 40° to 45° F, and the frost free period is 20 to 90 days.

In a representative profile the surface layer is very dark brown silty clay loam about 10 inches thick. The upper 17 inches of the subsoil is very dark brown clay, and the lower 27 inches is brown clay. The substratum is clayey, waterlaid sediment several feet thick. The surface layer is slightly acid, the upper part of the subsoil is neutral, and the lower part of the subsoil is medium acid to neutral.

Permeability is slow, available water capacity is 3 to 7 inches, and the water supplying capacity is 13 to 16 inches. Effective rooting depth is 20 to 40 inches.

These soils are used for timber, grazing, and wildlife habitat.

Representative profile of Hankins silty clay loam, 5 to 35 percent slopes, about 8 miles north of Dayville on section line on Franks Creek Road and 1,570 feet south of the northwest corner of section 33, T. 11 S., R. 27 E.:

A11—0 to 5 inches; very dark brown (10YR 2/2) silty clay loam, grayish brown (10YR 5/2) dry; weak thin platy structure parting to moderate fine granular; slightly hard, very friable, slightly sticky, slightly plastic; many very fine roots; common fine irregular pores; slightly

acid (pH 6.4); abrupt smooth boundary; 3 to 8 inches thick.

A12—5 to 10 inches; very dark brown (10YR 2/2) silty clay loam, grayish brown (10YR 5/2) dry; strong fine subangular blocky structure; hard, friable, sticky, plastic; common very fine roots; few fine common very fine tubular pores; neutral (pH 6.6); abrupt smooth boundary; 4 to 12 inches thick.

IIB21t—10 to 16 inches; very dark brown (10YR 2/3) clay, dark brown (10YR 4/3) dry; weak medium prismatic structure parting to moderate fine and medium blocky structure; extremely hard, very firm, very sticky, very plastic; common very fine and fine roots; few fine common very fine tubular pores; continuous moderately thick clay films or pressure faces on faces of peds; neutral (pH 6.6); clear smooth boundary; 5 to 10 inches thick.

IIB22t—16 to 27 inches; dark brown (10YR 3/3) clay, brown (10YR 5/3) dry; weak medium prismatic structure parting to moderate subangular blocky; very hard, very firm, very sticky, very plastic; common very fine and fine roots; few fine and very fine tubular pores; continuous moderately thick continuous clay films on ped faces; neutral (pH 6.6); clear smooth boundary; 5 to 15 inches thick.

IIB31t—27 to 35 inches; dark brown (10YR 4/3) clay, brown (10YR 5/3) dry; moderate medium subangular blocky structure; very hard, very firm, very sticky, very plastic; few fine roots; common very fine tubular pores; common moderately thick clay films in pores, few thin clay films on ped faces; slightly acid (pH 6.4); gradual wavy boundary; 0 to 15 inches thick.

IIB32t—35 to 45 inches; brown (10YR 5/3) clay, very pale brown (10YR 7/3) dry; moderate medium and fine subangular blocky structure; slightly brittle when moist, crushes with moderate pressure; very hard, firm, sticky, plastic; few fine roots; few fine tubular pores; few thin clay films on peds and common moderately thick clay films in pores; medium acid (pH 6.0); gradual wavy boundary; 0 to 15 inches thick.

IIB33—45 to 54 inches; brown (10YR 5/3) clay, very pale brown (10YR 7/3) dry; moderate fine and very fine subangular blocky structure; very hard, firm, sticky, plastic; few fine roots; few fine and very fine tubular pores; common moderately thick clay films in pores; neutral (pH 6.8).

Depth to bedrock is more than 40 inches. Rock fragments in the profile range from about 1 to 35 percent. In the A1 horizon value is 2 or 3 moist and 3 to 5 dry and chroma is 1 or 2. The A1 horizon is silt loam or silty clay loam. In the B2t horizon hue is 10YR or 7.5YR. In the upper part of the B2t horizon value is 2 or 3 moist and 4 or 5 dry, and in the lower part value is 3 to 5 moist and 5 to 7 dry.

19E—Hankins silt loam, 10 to 45 percent north slopes. This soil has a profile similar to the one described as representative of the series, but it has a silt loam surface layer. Areas range from 100 to about 400 acres in size.

Included with this soil in mapping are areas of McGarr soils, light colored soils derived from volcanic ash, and Top soils. These areas make up as much as 15 percent of the mapping unit.

Runoff is medium to rapid, and the hazard of erosion is high. Capability unit VIe; woodland group 3o3; wildlife group 5.

20E—Hankins silty clay loam, 5 to 35 percent slopes. This soil has south facing slopes. It has the profile described as representative of the series. Areas range from 100 to about 1,000 acres in size.

Included with this soil in mapping are areas of McGarr, Top, and Alding soils. These areas make up as much as 15 percent of the mapping unit.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. Capability unit VIe; woodland group 4o1; wildlife group 5.

Helter Series

The Helter series consists of well drained soils that formed in volcanic ash, loess, and residuum weathered from basalt on uplands. Slopes are 3 to 60 percent. Elevation is 4,500 to 5,500 feet. The vegetation is Douglas-fir, white fir, western larch, lodgepole pine, shrubs, and grasses. The average annual precipitation is 22 to 30 inches, the average annual air temperature is 40° to 44° F, and the frost free period is 20 to 60 days.

In a representative profile a layer of partly decomposed organic litter overlies 5 inches of strong brown silt loam. The next 18 inches is yellowish brown and light yellowish brown silt loam. Below this is dark brown clay loam about 37 inches thick. The upper part of the surface layer is medium acid, and the lower part is slightly acid. The upper part of the subsoil is slightly acid, and the lower part is neutral.

Permeability is moderately slow, available water capacity is 10 to 20 inches, and the water supplying capacity is 15 to 20 inches. Effective rooting depth is 40 to 60 inches.

These soils are used for timber and wildlife habitat.

Representative profile of Helter silt loam, 15 to 40 percent slopes, 100 feet west of road junction in the SW¼SW¼SW¼ section 15, T. 11 S., R. 27 E.:

O1—2 inches to 0; loose partly decomposed organic litter; ½ inch to 3 inches thick.

B21—0 to 5 inches; dark brown (7.5YR 4/4) silt loam, light yellowish brown (10YR 6/4) dry; weak very fine subangular blocky structure; soft, friable, nonsticky and slightly plastic; many very fine roots; many fine irregular discontinuous pores; medium acid (pH 6.0); clear wavy boundary; 0 to 6 inches thick.

B22—5 to 15 inches; yellowish brown (10YR 5/5) silt loam, very pale brown (10YR

7/4) dry; weak very fine subangular blocky structure; soft, friable, nonsticky and slightly plastic; many medium roots; many fine irregular continuous pores; medium acid (pH 6.0); clear wavy boundary; 4 to 12 inches thick.

C—15 to 23 inches; light yellowish brown (10YR 6/4) silt loam, very pale brown (10YR 7/3) dry; massive; soft, friable, nonsticky and slightly plastic; many very fine to medium roots; many fine irregular discontinuous pores; slightly acid (pH 6.2); abrupt wavy boundary; 5 to 15 inches thick.

IIB21b—23 to 32 inches; dark brown (10YR 3/3) heavy loam, dark yellowish brown (10YR 4/4) dry; moderate very fine subangular blocky structure; friable, slightly sticky and slightly plastic; many very fine to medium roots; many very fine irregular continuous pores; slightly acid (pH 6.1); gradual wavy boundary; 7 to 27 inches thick.

IIB22b—32 to 60 inches; dark brown (10YR 3/3) clay loam, yellowish brown (10YR 5/4) dry; moderate fine subangular blocky structure; friable, sticky and plastic; common very fine to medium roots; many very fine irregular continuous pores; 5 percent cobbles; slightly acid (pH 6.2).

Depth to bedrock is 40 to 60 inches. In the A1 horizon value is 3 or 4 moist and 5 or 6 dry. In the B2 horizon value is 4 or 5 moist and 6 or 7 dry. The IIB1b and IIB22b horizons are silt loam, loam, silty clay loam, or clay loam.

21C—Helter silt loam, 3 to 15 percent slopes. This soil is on uplands. Areas range from 100 to about 400 acres in size.

Included with this soil in mapping are areas of Anatone soils, soils similar to Helter except the depth to bedrock is 20 to 40 inches, and soils that formed in volcanic ash more than 40 inches thick. These areas make up as much as 15 percent of the mapping unit.

Runoff is slow, and the hazard of erosion is moderate. Capability unit VIe; woodland group 3o2; wildlife group 5.

21E—Helter silt loam, 15 to 40 percent slopes. This soil has north facing slopes. It has the profile described as representative of the series. Areas range from 100 to about 400 acres in size.

Included with this soil in mapping are areas of Rock outcrop, soils similar to Helter soils except the depth to bedrock is 20 to 40 inches, and soils that formed in volcanic ash more than 40 inches thick. These areas make up as much as 15 percent of the mapping unit.

Runoff is medium to rapid, and the hazard of erosion is high. Capability unit VIe; woodland group 3o2; wildlife group 5.

21F—Helter silt loam, 40 to 60 percent slopes. This soil has north facing slopes. Areas range from 100 to about 500 acres in size.

Included with this soil in mapping are areas of Rock outcrop, soils similar to Helter soils except that depth to bedrock is 20 to 40 inches, and soils that formed in volcanic ash more than 40 inches thick. These areas make up as much as 15 percent of the mapping unit.

Runoff is rapid, and the hazard of erosion is high. Capability unit VIIe; woodland group 3r3; wildlife group 5.

Laycock Series

The Laycock series consists of well drained soils on uplands. These soils formed in very shaly colluvium weathered from fractured shale interbedded in places with sandstone and graywacke. Slopes are 15 to 75 percent. Elevation is 3,500 to 5,500 feet. The vegetation is ponderosa pine, Douglas-fir, elk sedge, and pinegrass. The average annual precipitation is 17 to 22 inches, the average annual air temperature is 40° to 45° F, and the frost free period is 20 to about 80 days.

In a representative profile the surface layer is black very shaly loam about 9 inches thick. The next layer is dark brown very shaly light clay loam about 8 inches thick. The substratum is dark gray and very dark gray highly fractured shale bedrock. The soil above shale bedrock is slightly acid.

Permeability is moderate, available water capacity is 2 to 4 inches, and the water supplying capacity is 10 to 14 inches. Effective rooting depth is about 40 inches.

These soils are used for timber, grazing, and wildlife habitat.

Representative profile of Laycock very shaly loam in an area of Piersonte-Logdell-Laycock complex, 45 to 70 percent north slopes, about 5 miles southwest of Mt. Vernon in the SW¼SW¼ section 12, T. 14 S., R. 29 E.:

A1—0 to 9 inches; black (10YR 2/1) very shaly loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; soft, very friable, slightly sticky, slightly plastic; many very fine roots; 70 percent angular rock fragments (60 percent pebbles, 10 percent cobbles); slightly acid (pH 6.2); clear wavy boundary; 7 to 12 inches thick.

AC—9 to 17 inches; dark brown (10YR 3/3) very shaly light clay loam, brown (10YR 4/3) dry; weak very fine subangular structure; slightly hard, friable, slightly sticky, plastic; many very fine to medium roots; many very fine to medium pores; 70 percent angular rock fragments, (60 percent pebbles, 10 percent cobbles); slightly acid (pH 6.4); gradual wavy boundary; 6 to 20 inches thick.

C—17 to 60 inches; dark gray (10YR 4/1) and very dark gray (10YR 3/1) highly fractured shale bedrock; fractures ½ inch to 4 inches apart; voids not all filled with fine material.

Depth to finely fractured shale ranges from 14 to 30 inches. Depth to solid coherent bedrock is more than 60 inches. In the A1 and AC horizons, hue ranges from 10YR to 7.5YR. In the A horizon value is 2 or 3 moist and 3 or 4 dry, and chroma is 1 or 2. The A

horizon is loam or light clay loam. It is 35 to 75 percent rock fragments that are dominantly pebble size.

22E—Laycock-Logdell complex, 15 to 45 percent north slopes. This complex is about 40 percent Laycock very shaly loam and about 35 percent Logdell very shaly loam. The Laycock soil is in concave areas, and the Logdell soil is in convex or nose point areas. These soils are generally within 50 yards or less of each other. The Logdell soil has the profile described as representative of the Logdell series.

Included with this complex in mapping are areas of a soil similar to Laycock soils, but it has a thick, dark colored surface layer or has a few shale pebbles in the surface layer and subsurface layer. Also included are areas of Piersonte soils and shale outcrop. These areas make up about 25 percent of the mapping unit.

Runoff is moderate to rapid, and the hazard of erosion is moderate or high. Capability unit VIs. The Laycock soil is in woodland group 3f1 and wildlife group 5. The Logdell soil is in Mahogany Rockland range site and wildlife group 5.

23E—Laycock-Logdell complex, 15 to 45 percent south slopes. This complex is about 40 percent Laycock very shaly loam and about 35 percent Logdell very shaly loam. The Laycock soil is in concave areas, and the Logdell soil is in convex or nose point areas. These soils are generally within 50 yards or less of each other.

Included with this complex in mapping are areas of a soil similar to Laycock soil, but it has a thick, dark colored surface layer or has a few shale pebbles in the surface layer and subsurface layer. Also included are areas of Piersonte soils and shale outcrop. These areas make up about 25 percent of the mapping unit.

Runoff is moderate to rapid, and the hazard of erosion is moderate to high. Capability unit VIs. The Laycock soil is in woodland group 4f1 and wildlife group 5. The Logdell soil is in Mahogany Rockland range site and wildlife group 5.

23F—Laycock-Logdell complex, 45 to 75 percent south slopes. This complex is about 40 percent Laycock very shaly loam and about 40 percent Logdell very shaly loam. The Laycock soil is in concave areas, and the Logdell soil is in convex or nose-point areas. These soils are generally within 50 yards or less of each other.

Included with this complex in mapping are areas of soils similar to Laycock soils, but they have a thick, dark colored surface layer or have less shale in the surface layer and subsurface layer. Also included are areas of Piersonte soils and shale outcrop. These areas make up about 20 percent of the mapping unit.

Runoff is rapid, and the hazard of erosion is high. Capability unit VIIs. The Laycock soil is in woodland group 4f2 and wildlife group 5. The Logdell soil is in Mahogany Rockland range site and wildlife group 5.

Lemonex Series

The Lemonex series consists of well drained soils that formed on uplands in mixed colluvium and residuum weathered mostly from serpentine. Slopes are 3 to 75 percent. Elevation is 3,800 to 5,500 feet. The vegetation is ponderosa pine, Douglas-fir, elk sedge, and pinegrass. The average annual precipitation is 17 to 24 inches, the average annual air temperature is 40° to 45° F, and the frost free period is 20 to 80 days.

In a representative profile the surface layer is black stony clay loam about 8 inches thick. The upper 5 inches of the subsoil is very dark grayish brown gravelly clay, and the lower 14 inches is olive gravelly clay. Depth to hard serpentine bedrock is about 27 inches. The soil is neutral throughout its profile.

Permeability is slow, available water capacity is 2 to 5 inches, and the water supplying capacity is 11 to 14 inches. Effective rooting depth is 20 to 40 inches.

These soils are used for timber, grazing, and wildlife habitat.

Representative profile of Lemonex stony clay loam, 10 to 45 percent slopes, about 5 miles south and 1½ miles east of Mt. Vernon, 770 feet south of road junction in the NE¼SW¼ section 23, T. 14 S., R. 30 E.:

O1—1 inch to 0; pine needles, twigs, and leaves; abrupt smooth boundary; 1 to 3 inches thick.

A1—0 to 2 inches; black (10YR 2/1) stony clay loam, dark gray (10YR 4/1) dry; moderate fine granular structure; slightly hard, friable, slightly sticky, slightly plastic; many very fine roots; common fine discontinuous pores; neutral (pH 6.6); clear smooth boundary; 2 to 10 inches thick.

A3—2 to 8 inches; black (10YR 2/1) heavy clay loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; slightly hard, firm, sticky, plastic; many very fine common medium and few coarse roots; common fine discontinuous pores; neutral (pH 6.8); clear smooth boundary; 0 to 10 inches thick.

B21t—8 to 13 inches; very dark grayish brown (10YR 3/2) gravelly clay, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure parting to moderate very fine subangular blocky; hard, firm, sticky, plastic; common fine and few coarse roots; common fine continuous pores; many moderately thick clay films on faces of peds; 20 percent fine serpentine pebbles; neutral (pH 6.8); clear smooth boundary; 4 to 15 inches thick.

B22t—13 to 27 inches; olive (5Y 4/4) gravelly clay, pale olive (5Y 6/3) dry; moderate medium subangular blocky structure; extremely hard, firm, sticky, very plastic; common fine and few coarse roots; common very fine continuous tubular pores; common moderately thick clay films on faces of peds; 30 percent serpentine pebbles; neutral (pH 7.0); abrupt smooth boundary; 8 to 16 inches thick.

R—27 inches; hard fractured serpentine bedrock.

The depth to hard bedrock ranges from 20 to 40 inches. In the A1 horizon and upper part of the B2 horizon, hue ranges from 10YR to 2.5Y. Chroma is 1 or 2 in the A1 horizon. In the upper part of the B horizon value is 3 or 4 dry and chroma is 2 or 3; in the

lower part value is 3 or 4 moist and 4 to 6 dry. Chroma is 2 or 3 in the lower part of the B horizon.

24E—Lemonex stony clay loam, 10 to 45 percent slopes. This soil has north facing slopes. It has the profile described as representative of the series. Areas range from 100 to about 300 acres in size.

Included with this soil in mapping are areas of Hankins, Ruddley, and Alding soils. These areas make up as much as 15 percent of the mapping unit.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. Capability unit VIe; woodland group 3ol; wildlife group 5.

25E—Lemonex-Rock outcrop complex, 3 to 45 percent slopes. This complex is about 50 percent Lemonex very stony clay loam, about 20 percent Rock outcrop, and about 15 percent Lithic Xerochrepts, which are very stony or very cobbly clays or clay loams about 3 to 15 inches deep to bedrock. It has south facing slopes. The Rock outcrop and Lithic Xerochrepts are near ridgetops, on convex slopes, and in small elongated areas at right angles to the slope. The Lemonex soil is between and around areas of Rock outcrop and Lithic Xerochrepts. The Lemonex soil has a profile similar to the one described as representative of the Lemonex series, but the surface is very stony.

Included with this complex in mapping are areas of Alding and Hankins soils. These areas make up about 15 percent of the mapping unit.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. Capability unit VIIs. The Lemonex soil is in woodland group 4x1 and wildlife group 5. Rock outcrop is not placed in a range site, woodland group, or wildlife group. Lithic Xerochrepts are in Mahogany Rockland range site and wildlife group 5.

Lickskillet Series

The Lickskillet series consists of well drained soils that formed in colluvium. Slopes are 20 to 70 percent. Elevation is 2,100 to 3,200 feet. The vegetation is bluebunch wheatgrass, Sandberg bluegrass, forbs, and shrubs. The average annual precipitation is 11 to 14 inches, the average annual air temperature is 49° to 51° F, and the frost free period is 120 to 150 days.

In a representative profile the surface layer is dark brown extremely stony loam about 8 inches thick. The subsoil is dark brown very gravelly clay loam about 7 inches thick. Depth to basalt bedrock is about 15 inches. The soil is neutral throughout its profile.

Permeability is moderate, available water capacity is 1 inch to 3 inches, and the water supplying capacity is 2 to 5 inches. Effective rooting depth is 12 to 20 inches.

These soils are used for range and wildlife habitat.

Representative profile of Lickskillet extremely stony loam in an area of Lickskillet-Rock outcrop complex, 20 to 70 percent slopes, in the NE¼NE¼ section 25, T. 13 S., R. 26 E.:

A11—0 to 4 inches; dark brown (7.5YR 3/2) extremely stony loam, brown (7.5YR 4/3) dry; weak medium and fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine and very fine roots; many very fine irregular pores; 20 percent pebbles, 40 percent cobbles, 20 percent stones; neutral (pH 6.8); clear smooth boundary; 3 to 8 inches thick.

A12—4 to 8 inches; very dark grayish brown (10YR 3/2) very gravelly loam, brown (10YR 4/3) dry; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine and very fine roots; many very fine irregular pores; 20 percent pebbles, 40 percent cobbles, 10 percent stones; neutral (pH 6.8); abrupt wavy boundary; 0 to 5 inches thick.

B2—8 to 15 inches; dark brown (7.5YR 3/4) very gravelly clay loam, brown (7.5YR 4/4) dry; weak medium subangular blocky structure; slightly hard, friable, sticky and plastic; common fine and very fine roots; common very fine irregular pores; 50 percent pebbles, 20 percent cobbles, 10 percent stones; neutral (pH 6.8); abrupt wavy boundary; 6 to 14 inches thick.

R—15 inches; basalt bedrock.

Depth to basalt bedrock is 12 to 20 inches. The profile is 40 to 80 percent rock fragments.

26F—Lickskillet-Rock outcrop complex, 20 to 70 percent slopes. This complex is about 45 percent Lickskillet extremely stony loam and about 35 percent Rock outcrop. It is on uplands and is underlain by several different, nearly exposed and exposed basalt flows. The Lickskillet soil is in small, elongated areas oriented roughly at right angles to the slope. The Rock outcrop is on ridgetops, on convex or nose point slopes, and on basalt rims. The Lickskillet soil has the profile described as representative of the Lickskillet series.

Included with this complex in mapping are areas of very stony soils 5 to 12 inches deep and medium textured soils 20 to 40 inches deep that have north facing slopes. These areas make up as much as 15 percent of the mapping unit.

Runoff is rapid, and the hazard of erosion is high. Capability unit VIIs. The Lickskillet soil is in Droughty South Exposure range site and wildlife group 3. Rock outcrop is not placed in a range site or wildlife group.

Lithic Xerochrepts

Lithic Xerochrepts are mapped only in complexes with Alding, Daxty, Lemonex, and Ruddley soils and Rock outcrop. They consist of well drained soils that formed on uplands in colluvium and residuum weathered from metavolcanic rock, volcanic tuff, and serpentine. Slopes are 3 to 70 percent. Elevation is 3,800 to 5,500 feet. The vegetation is curlleaf mountain-mahogany, Idaho fescue, and bluebunch wheatgrass. The average annual precipitation is 17 to 24 inches, the average annual air temperature is 40 to 45° F, and the frost free period is 20 to 90 days.

The surface layer and subsoil vary in texture. They are very gravelly clay, very cobbly clay, and very stony clay; very gravelly clay loam, flaggy clay loam, very

flaggy clay loam, very cobbly clay loam, and very stony clay loam; and flaggy loam, very flaggy loam, and very cobbly loam. Depth to bedrock is 3 to 15 inches.

Permeability, available water capacity, and water supplying capacity vary. Effective rooting depth is 3 to 15 inches.

These soils are used for grazing and wildlife habitat. Capability unit VIIs; Mahogany Rockland range site; wildlife group 5.

Logdell Series

The Logdell series consists of well drained soils on uplands. These soils formed in shaly colluvium and residuum weathered from finely fractured shale interbedded in places with sandstone and graywacke. Slopes are 15 to 75 percent. Elevation is 3,500 to 5,500 feet. The vegetation is mountainmahogany, bitterbrush, Idaho fescue, and bluebunch wheatgrass. The average annual precipitation is 17 to 22 inches, the average annual air temperature is 40° to 45° F, and the frost free period is 20 to 80 days.

In a representative profile the surface layer is very dark brown very shaly loam about 8 inches thick. The substratum is dark gray highly fractured shale that extends to a depth of 60 inches or more. The surface layer is neutral.

Permeability is moderate, available water capacity is 0.5 to 2 inches, and the water supplying capacity is 8 to 10 inches. Effective rooting depth for grasses is 4 to 14 inches. Shrub roots follow the fractures to a depth of 3 to 4 feet or more.

These soils are used for range and wildlife habitat.

Representative profile of Logdell very shaly loam in an area of Piersonte-Logdell-Laycock complex, 45 to 70 percent north slopes, about 5 miles southwest of Mt. Vernon in the SW¼SW¼ section 12, T. 14 S., R. 29 E.:

A1—0 to 8 inches; very dark brown (10YR 2/2) very shaly loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; soft, friable, slightly sticky, slightly plastic; many very fine and few fine and medium roots; many very fine pores; 50 percent angular shale pebbles, 10 percent cobbles; neutral (pH 6.6); clear wavy boundary; 7 to 14 inches thick.

C—8 to 60 inches; dark gray (N 4/0) highly fractured shale bedrock; fractures ½ inch to 4 inches apart, not all voids and cracks filled with fine material.

Depth to the finely fractured shale bedrock ranges from 7 to 14 inches. The A1 horizon ranges from slightly acid to neutral. In the A1 horizon hue is 10YR or 7.5YR, value is 2 or 3 moist and 3 to 5 dry, and chroma is 2 or 3 moist or dry. The A1 horizon is loam to light clay loam.

27F—Logdell very shaly loam, 45 to 70 percent north slopes. This soil has a profile similar in morphology to the one described as representative of the series. Areas range from 100 to about 400 acres in size.

Included with this soil in mapping are areas of Laycock soils, shaly soils 10 to 20 inches deep over hard bedrock that has few fractures, and shale outcrop. These areas make up about 15 percent of the mapping unit.

Runoff is rapid, and the hazard of erosion is high. Capability unit VIIs; Mahogany Rockland range site; wildlife group 5.

McGarr Series

The McGarr series consists of well drained soils that formed in loess and in colluvium weathered from basalt on uplands. Slopes are 5 to 75 percent. Elevation is 3,500 to 5,500 feet. The vegetation is Douglas-fir, ponderosa pine, pinegrass, and elk sedge. The average annual precipitation is 17 to 25 inches, the average annual air temperature is 40° to 45° F, and the frost free period is 20 to 60 days.

In a representative profile the surface layer is 7 inches of very dark brown stony loam over 7 inches of dark brown loam. The upper 5 inches of the subsoil is dark brown clay loam, and the lower 12 inches is dark brown cobbly clay loam. Depth to basalt bedrock is about 31 inches. The surface layer and the upper part of the subsoil are slightly acid, and the lower part of the subsoil is neutral.

Permeability is moderately slow, available water capacity is 3 to 7 inches, and the water supplying capacity is 13 to 17 inches. Effective rooting depth is 20 to 40 inches.

These soils are used for timber, grazing, and wildlife habitat.

Representative profile of McGarr stony loam, 5 to 45 percent slopes, in NE¼SE¼ section 8, T. 11 S., R. 27 E.:

O—½ inch to 0; twigs and needles.

A1—0 to 7 inches; very dark brown (10YR 2/2) stony loam, brown (10YR 4/3) dry; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; many very fine irregular pores; 5 percent stones; slightly acid (pH 6.2); clear smooth boundary; 6 to 12 inches thick.

A3—7 to 14 inches; dark brown (10YR 3/3) loam, brown (10YR 4/3) dry; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; many fine continuous pores; slightly acid (pH 6.4); clear smooth boundary; 0 to 8 inches thick.

B1—14 to 19 inches; dark brown (10YR 3/3) clay loam, brown (10YR 4/3) dry; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and plastic; common fine and very fine roots; many fine continuous pores; slightly acid (pH 6.4); clear smooth boundary; 0 to 6 inches thick.

B2—19 to 31 inches; dark brown (10YR 3/3) cobbly clay loam, brown (10YR 4/3)

dry; weak medium subangular blocky structure; slightly hard, firm, sticky and plastic; common fine and very fine roots; common very fine continuous pores; 5 percent pebbles, 10 percent cobbles, and 10 percent stones; neutral (pH 6.6); abrupt smooth boundary.

R—31 inches; basalt bedrock.

Depth to bedrock is 20 to 40 inches. The soil is slightly acid to neutral throughout its profile. Hue is 10YR or 7.5YR. The material in the profile is 5 to 15 percent pebbles and 5 to 20 percent cobbles and stones. In the A1 horizon value is 2 or 3 moist and 4 or 5 dry. In the B2 horizon value is 3 or 4 moist and 4 or 5 dry, and chroma is 2 to 4 moist or dry.

28E—McGarr stony loam, 5 to 45 percent slopes. This soil has complex, north facing slopes. It has the profile described as representative of the series. Areas range from 100 to about 500 acres in size.

Included with this soil in mapping are areas of Hankins, Anatone, and Top soils and Rock outcrop. These areas make up as much as 15 percent of the mapping unit.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. Capability unit VIe; woodland group 3o1; wildlife group 5.

28F—McGarr stony loam, 45 to 75 percent slopes. This soil has north facing slopes. Areas range from 100 to about 500 acres in size.

Included with this soil in mapping are areas of Top and Anatone soils, soils similar to McGarr soils except for 6 to 10 inches of volcanic ash overlay, and Rock outcrop. These areas make up as much as 15 percent of the mapping unit.

Runoff is rapid, and the hazard of erosion is high. Capability unit VIIe; woodland group 3r2; wildlife group 5.

29F—McGarr-Anatone complex, 5 to 65 percent slopes. This complex is about 40 percent McGarr very stony loam and about 40 percent Anatone extremely stony loam. It has south facing slopes. The Anatone soil is on ridgetops; in small, irregularly shaped, largely random areas; and in narrow bands at right angles to the slope. The McGarr soil is between and around areas of Anatone soils. The profile of the McGarr soil is similar to the one described as representative of that series, but the surface layer is very stony. The Anatone soil has the profile described as representative of the Anatone series.

Included with this complex in mapping are areas of Top soils, very stony soils 5 to 10 inches deep, and soils similar to McGarr soils except for 6 to 10 inches of volcanic ash overlay. These areas make up about 15 percent of the mapping unit.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. Capability unit VIIs. The McGarr soil is in woodland group 4x1 and wildlife group 5. The Anatone soil is in Scabland range site and wildlife group 5.

Oxbow Series

The Oxbow series consists of well drained soils that formed in alluvium on old terraces. Slopes are 2 to 5 percent. Elevation is 2,700 to 4,200 feet. The vegetation is bluebunch wheatgrass, Idaho fescue, and Canby bluegrass. The average annual precipitation is 14 to 18 inches, the average annual air temperature is 47° to 50° F, and the frost free period is 90 to 140 days.

In a representative profile the surface layer is black very stony heavy silty clay loam about 8 inches thick. The upper 10 inches of the subsoil is mostly dark brown clay, and the lower 9 inches is dark yellowish brown, calcareous clay. An indurated hardpan is at a depth of about 27 inches. The subsoil is about 15 percent cobbles and stones. The surface layer is slightly acid, the upper part of the subsoil is neutral, and the lower part of the subsoil is moderately alkaline.

Permeability is slow, available water capacity is 4 to 6 inches, and the water supplying capacity is 8 to 12 inches. Effective rooting depth is 20 to 40 inches.

These soils are used mainly for range and wildlife habitat. Some areas are used for irrigated pasture and hay.

Representative profile of Oxbow very stony silty clay loam, 2 to 5 percent slopes, 420 feet west of Pine Creek Road in the SW¼NE¼ section 26, T. 13 S., R. 32 E.:

A11—0 to 4 inches; black (10YR 2/1) very stony heavy silty clay loam, dark gray (10YR 4/1) dry; moderate thin and very thin platy structure; hard, friable, sticky, plastic; many roots; 5 percent stone size rock fragments; about 3 percent of surface covered with stones; slightly acid (pH 6.4); clear smooth boundary; 3 to 6 inches thick.

A12—4 to 8 inches; black (10YR 2/1) heavy silty clay loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; hard, friable, sticky, plastic; many roots; common very fine tubular pores; 5 percent stone size rock fragments; slightly acid (pH 6.5); clear smooth boundary; 3 to 7 inches thick.

B1t—8 to 12 inches; very dark brown (10YR 2/2) heavy silty clay loam, dark grayish brown (10YR 4/2) dry; moderate fine and very fine subangular blocky structure; hard, firm, sticky, plastic; common roots; common very fine tubular pores; continuous moderately thick clay films; 15 percent stones and cobbles; neutral (pH 6.6); abrupt smooth boundary; 0 to 6 inches thick.

B21t—12 to 18 inches; dark brown (10YR 3/3) clay, brown (10YR 4/3) dry; moderate medium prismatic and strong fine blocky structure; very hard, very firm, very sticky, very plastic; few roots; few fine and very fine tubular pores; continuous moderately thick clay films; 15 percent stones and cobbles; neutral (pH 6.7); clear smooth boundary; 4 to 10 inches thick.

B22tca—18 to 27 inches; dark yellowish brown (10YR 4/4) clay, yellowish brown (10YR 5/4) dry; moderate fine subangular blocky structure; very hard, very

firm, very sticky, very plastic; few roots; few very fine tubular pores; continuous thick clay films; 15 percent lime coated stones and cobbles; weakly calcareous with disseminated lime; moderately alkaline (pH 8.1); abrupt smooth boundary; 8 to 12 inches thick.

IICcasim—27 to 35 inches; silica and lime cemented gravelly duripan with laminar capping on horizontal surfaces; massive and indurated.

Depth to the indurated hardpan is 20 to 40 inches. Stratified sandy, gravelly, and strongly cemented layers underlie the duripan to a depth of 60 inches or more. The A horizon is very stony heavy silty clay loam, very stony silty clay, or very stony clay. In the A horizon, value is 4 or 5 dry and 2 or 3 moist. The A horizon is 5 to 20 percent cobbles and stones and 0 to 15 percent gravel. The B2t horizon is 10 to 30 percent rock fragments.

30B—Oxbow very stony silty clay loam, 2 to 5 percent slopes. This soil is on old terraces. Areas range from 50 to about 500 acres in size.

Included with this soil in mapping are areas of Oxwall, Tub, and Simas soils. These areas make up as much as 15 percent of the mapping unit.

Runoff is slow, and the hazard of erosion is slight. Capability unit IVs–1 irrigated and VIs; Droughty Terrace range site; wildlife group 2 irrigated and 4 dryland.

Oxwall Series

The Oxwall series consists of well drained soils that formed in alluvium on old terraces. Slopes are 2 to 7 percent. Elevation is 2,700 to 4,200 feet. The vegetation is bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. The average annual precipitation is 14 to 18 inches, the average annual air temperature is 47° to 50° F, and the frost free period is 90 to 140 days.

In a representative profile the surface layer is very dark brown very stony silty clay loam about 8 inches thick. The subsoil is very dark brown clay about 5 inches thick. An indurated hardpan is at a depth of about 13 inches.

Permeability is slow, available water capacity is 1.3 to 3.5 inches, and the water supplying capacity is 7 to 10 inches. Effective rooting depth is 10 to 20 inches.

These soils are used for range and wildlife habitat.

Representative profile of Oxwall very stony silty clay loam, 2 to 7 percent slopes, 2 miles southeast of Prairie City and 500 feet south of paved county road in the SW¼NW¼ section 18, T. 13 S., R. 34 E.:

A11—0 to 2 inches; very dark brown (10YR 2/2) very stony silty clay loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; slightly hard, friable, sticky, plastic; many roots; 5 percent pebbles and cobbles; 3 percent of surface covered with stones; slightly acid (pH 6.4); abrupt smooth boundary; 2 to 4 inches thick.

A12—2 to 8 inches; very dark brown (10YR 2/2) gravelly heavy silty clay loam, dark grayish brown (10YR 4/2) dry; moderate fine and very fine subangular blocky structure; hard, friable, sticky, plastic; many roots; 20 percent pebbles and small cobbles; neutral (pH 6.5); clear smooth boundary; 3 to 8 inches thick.

B2t—8 to 13 inches; very dark brown (10YR 2/3) clay, dark brown (10YR 3/3) dry; moderate medium and fine prismatic structure parting to strong medium and fine blocky; very hard, firm, very sticky, very plastic; few roots; few very fine tubular pores; continuous moderately thick clay films; common intersecting slickensides; 5 percent cobbles; neutral (pH 6.7); abrupt smooth boundary; 4 to 10 inches thick.

IICsim—13 to 20 inches; indurated silica cemented gravelly duripan; massive; continuous laminar capping.

Depth to the indurated hardpan ranges from 10 to 20 inches. Stratified sandy, gravelly, and strongly cemented layers underlie the duripan to a depth of 60 inches or more. In the A1 horizon value is 4 or 5 dry, and chroma is 1 or 2 moist or dry. Rock fragments range from 5 to about 20 percent. As much as 15 percent of the surface is covered with stones. In the B2t horizon hue is 7.5YR or 10YR, value is 3 to 5 dry, and chroma is 3 or 4 moist or dry. The clay content ranges from 40 to 60 percent. Rock fragments range from 5 to 30 percent.

31B—Oxwall very stony silty clay loam, 2 to 7 percent slopes. This soil is on old terraces. It has the profile described as representative of the series.

Included with this soil in mapping are areas of Oxbow and Tub soils. These areas make up about 15 percent of the mapping unit.

Runoff is slow, and the hazard of erosion is slight. Capability unit VIs; Droughty Terrace range site; wildlife group 4.

32B—Oxwall extremely stony silty clay loam, 2 to 7 percent slopes. This soil is on old terraces. It has a profile similar to the one described as representative of the series, but it has an extremely stony surface layer.

Included with this soil in mapping were areas of Oxbow and Tub soils. These areas make up about 15 percent of the mapping unit.

Runoff is slow, and the hazard of erosion is slight. Capability unit VIIs; Droughty Terrace range site; wildlife group 4.

Piersonte Series

The Piersonte series consists of well drained soils that formed in colluvium weathered from shale on uplands. Slopes are 45 to 70 percent. Elevation is 3,500 to 5,500 feet. The vegetation is Douglas-fir, ponderosa pine, pinegrass, and elk sedge. The average annual precipitation is 17 to 22 inches, the average annual air temperature is 40° to 45° F, and the frost free period is 20 to about 60 days.

In a representative profile the surface layer is black shaly loam about 10 inches thick over very dark brown very shaly loam about 17 inches thick. The subsoil is dark yellowish brown very shaly loam about 23 inches

thick. The substratum is very shaly loam 10 or more inches thick. The soil is neutral throughout its profile.

Permeability is moderate, available water capacity is 3 to 6 inches, and the water supplying capacity is 10 to 14 inches. Effective rooting depth is 40 to 60 inches.

These soils are used for timber, grazing, and wildlife habitat.

Representative profile of Piersonte shaly loam in an area of Piersonte-Logdell-Laycock complex, 45 to 70 percent north slopes, in the SW¼SW¼ section 12, T. 14 S., R. 29 E.:

O1—1½ inches to 0; undecomposed and partly decomposed needles and twigs.

A1—0 to 10 inches; black (10YR 2/1) shaly loam, very dark brown (10YR 2/2) dry; weak very fine granular structure; loose, very friable, slightly sticky, slightly plastic; many very fine roots; many very fine irregular pores; 30 percent angular shale pebbles; neutral (pH 7.2); clear smooth boundary; 7 to 15 inches thick.

A3—10 to 27 inches; very dark brown (10YR 2/2) very shaly loam, very dark grayish brown (10YR 3/2) dry; weak very fine granular structure; soft, very friable, slightly sticky; slightly plastic; many very fine roots; many very fine irregular pores; 60 percent angular shale pebbles; neutral (pH 6.6); clear smooth boundary; 9 to 20 inches thick.

B2—27 to 50 inches; dark yellowish brown (10YR 4/4) very shaly loam, yellowish brown (10YR 5/4) dry; weak very fine subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; common very fine and medium roots; many very fine irregular pores; 60 percent angular shale pebbles; neutral (pH 6.6); clear smooth boundary; 15 to 30 inches thick.

C—50 to 60 inches; dark yellowish brown (10YR 4/4) very shaly loam, yellowish brown (10YR 5/4) dry; massive; slightly hard, very friable, slightly sticky, slightly plastic; few medium roots; many very fine irregular pores; 70 percent shale angular pebbles; neutral (pH 6.6).

Depth to finely fractured shale or to bedrock is 40 to more than 60 inches. Depth to hard coherent bedrock is more than 60 inches. The material in the profile ranges from slightly acid or neutral. In the A1 horizon value is 2 or 3 moist and 2 or 3 dry. Chroma is 1 or 2 in this horizon. The A1 horizon is loam and 20 to 40 percent shale pebbles. The A3 horizon is loam and 35 to 75 percent shale pebbles. In the B horizon value is 3 or 4 moist and 4 or 5 dry. Chroma is 3 or 4. The B horizon is loam or light clay loam and 50 to 70 percent shale pebbles.

33F—Piersonte-Logdell-Laycock complex, 45 to 70 percent north slopes. This complex is about 30 percent Piersonte shaly loam, about 30 percent Logdell very shaly loam, and about 20 percent Laycock very shaly loam. These soils are in small areas that are generally within 50 yards or less of each other. The deep Piersonte soil is in concave areas, the Logdell soil is on convex or nose point slopes, and the Laycock soil is between these two soils. Each soil has the profile described as representative of its respective series.

Included with this complex in mapping are areas of a soil similar to Laycock soil except for a thick, dark colored surface layer and a soil similar to the Piersonte soil except the subsoil and substratum are less than 35 percent shale pebbles. Areas of shale outcrop are also included. These included areas make up about 20 percent of the mapping unit.

Runoff is rapid, and the hazard of erosion is high. Capability unit VIIs. The Piersonte soil is in woodland group 3f2 and wildlife group 5. The Logdell soil is in Mahogany Rockland range site and wildlife group 5. The Laycock soil is in woodland group 3f2 and wildlife group 5.

Powder Series

The Powder series consists of well drained soils that formed in mixed alluvium on bottom lands and low alluvial fans. Slopes are 0 to 3 percent. Elevation is 2,100 to 3,000 feet. In uncultivated areas the vegetation is giant wild rye, bluebunch wheatgrass, and Idaho fescue. The average annual precipitation is 10 to 13 inches, the average annual air temperature is 49° to 51° F, and the frost free period is 130 to 150 days.

In a representative profile the surface layer is very dark grayish brown, calcareous silt loam about 14 inches thick. The next layer is calcareous, dark brown silt loam about 18 inches thick and calcareous, dark brown sandy loam about 13 inches thick. Below this is very dark brown silt loam 15 inches or more thick.

Permeability is moderate, and available water capacity is 9 to 12 inches. Effective rooting depth is 50 inches or more.

These soils are used for irrigated crops, mainly alfalfa or alfalfa-grass hay and pasture.

Representative profile of Powder silt loam, occasional overflow, in the NE¼SE¼ section 20, T. 12 S., R. 26 E.:

Ap—0 to 4 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine roots; many fine irregular pores; weakly calcareous with disseminated lime; moderately alkaline (pH 8.0); abrupt smooth boundary; 4 to 7 inches thick.

A12—4 to 14 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak coarse prismatic structure that parts to weak medium subangular blocky; slightly hard, friable, slightly sticky and plastic; common fine roots; many fine continuous pores; weakly calcareous with disseminated lime; moderately alkaline (pH 8.0); clear smooth boundary; 6 to 12 inches thick.

AC1—14 to 32 inches; dark brown (10YR 3/3)

silt loam, grayish brown (10YR 5/2) dry; massive; slightly hard, friable, slightly sticky and plastic; common fine roots; many fine continuous pores; weakly calcareous with disseminated lime; moderately alkaline (pH 8.0); abrupt smooth boundary; 14 to 24 inches thick.

AC2—32 to 45 inches; dark brown (10YR 3/3) sandy loam, brown (10YR 5/3) dry; massive; soft, very friable, slightly sticky and nonplastic; common fine roots; common fine continuous pores; weakly calcareous with disseminated lime; moderately alkaline (pH 8.0); abrupt smooth boundary; 0 to 20 inches thick.

Ab—45 to 60 inches; very dark brown (10YR 2/2) silt loam, grayish brown (10YR 5/2) dry; massive; slightly hard, very friable, slightly sticky and plastic; common fine roots; common very fine continuous pores; very weakly calcareous; moderately alkaline (pH 8.0).

Depth to gravel is 50 inches or more. Between depths of 10 and 40 inches the soil is dominantly silt loam that is less than 18 percent clay and less than 15 percent material coarser textured than very fine sand. The soil is generally calcareous throughout, but the Ap horizon is noncalcareous in places. The soil is very dark grayish brown or dark brown to a depth of more than 20 inches.

34—Powder silt loam, occasional overflow. This soil is on bottom lands. Slopes are 0 to 3 percent. Areas range from 10 to about 100 acres in size.

Included with this soil in mapping are areas of Dayville soils, very gravelly soils, and Boyce soils. These areas make up as much as 15 percent of the mapping unit.

Runoff is slow, and the hazard of erosion is moderate. Occasional flooding occurs in winter or early in spring. Capability unit IIw–2 irrigated; not placed in a range site; wildlife group 2.

Ricco Series

The Ricco series consists of poorly drained soils that formed in recent alluvium on low alluvial fans and bottom land. Slopes are 0 to 3 percent. Elevation is 2,400 to about 4,000 feet. In uncultivated areas the vegetation is sedges, rushes, and tufted hairgrass. The average annual precipitation is 12 to 16 inches, the average annual air temperature is 45° to 52° F, and the frost free period is 100 to 150 days.

In a representative profile the upper 20 inches is black silty clay loam. The next 10 inches is very dark grayish brown silty clay loam. The substratum is very dark gray and dark gray silty clay loam 42 inches thick.

Permeability is slow, and available water capacity is 7 to 13 inches. Effective rooting depth is 24 to 40 inches.

These soils are used for irrigated hay and pasture and for wildlife habitat.

Representative profile of Ricco silty clay loam, about 6 miles southeast of Prairie City and ¼ mile west of old Riverside school in the SW¼ section 22, T. 13 S., R. 34 E.:

A11—0 to 3 inches; black (N 2/0) silty clay loam, gray (N 5/0) dry; moderate fine granular structure; slightly hard, friable, slightly sticky, slightly plastic; many very fine pores; many very fine roots; slightly acid (pH 6.2); clear smooth boundary; 2 to 7 inches thick.

A12—3 to 15 inches; black (N 2/0) silty clay loam, dark gray (N 4/0) dry; moderate medium subangular blocky structure; hard, friable, sticky, plastic; many very fine roots; many very fine and fine and few medium tubular pores; slightly acid (pH 6.3); gradual smooth boundary; 6 to 18 inches thick.

AC1—15 to 20 inches; black (N 2/0) silty clay loam, light gray (N 6/0) dry; moderate medium angular blocky structure; hard, friable, sticky, plastic; many very fine roots; common very fine and fine tubular pores; pH 6.7; gradual wavy boundary; 3 to 9 inches thick.

AC2—20 to 30 inches; very dark grayish brown (10YR 3/2) silty clay loam, light gray (10YR 6/1) dry; moderate medium and fine blocky structure; hard, friable, sticky, plastic; common very fine roots; common very fine pores; pH 6.7; clear smooth boundary; 5 to 15 inches thick.

C1—30 to 45 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) moist; massive; hard, friable, sticky, plastic; few very fine roots; common fine and very fine pores; neutral (pH 6.7); clear smooth boundary; 14 to 20 inches thick.

C2—45 to 72 inches; dark gray (10YR 4/1) silty clay loam, light gray (10YR 7/1) dry; massive; hard, friable, sticky, plastic; few very fine roots; common very fine pores; neutral (pH 6.7).

Depth to sand, gravel, or volcanic ash is more than 40 inches, and depth to bedrock is more than 60 inches. The profile is slightly acid to neutral. In the AC and C horizons, hue is 10YR or 2.5Y. Between depths of 10 and 40 inches, the profile is silty clay loam or clay. The A horizon is 7 to 10 percent organic matter. Loose gravel, sand, or volcanic ash are below a depth of 40 inches in some places.

35—Ricco silty clay loam. This soil is on bottom land and low alluvial fans. Slopes are 0 to 3 percent. Areas range from 10 to about 100 acres in size.

Included with this soil in mapping are areas of Boyce, Veazie, and Dayville soils. These areas make up as much as 15 percent of the mapping unit.

Runoff is slow, and the hazard of erosion is slight. Occasional flooding occurs in winter or early in spring. Capability unit IVw–1 irrigated; not placed in a woodland group or range site; wildlife group 1.

Rock Outcrop

Rock outcrop consists of areas that are more than

90 percent rock outcrop of basalt, serpentine, welded rhyolitic tuff, or metavolcanic rock. Vegetation is very sparse. Elevation is 2,100 to 5,500 feet. The average annual precipitation is 12 to 24 inches, the average annual air temperature is 40° to 51° F, and the frost free period is 20 to 150 days.

Rock outcrop is not suited to range, woodland, or wildlife habitat.

36F—Rock outcrop-Lemonex complex, 30 to 75 percent slopes. This complex is about 35 percent Rock outcrop, about 30 percent Lemonex very stony clay loam, and about 20 percent Lithic Xerochrepts, which are very stony or very cobbly clays or clay loams. It has south facing slopes. The Rock outcrop and Lithic Xerochrepts are near ridgetops and in elongated areas at right angles to the slope. The Lemonex soil is between areas of Rock outcrop and Lithic Xerochrepts, mainly on concave slopes and on footslopes. The Lemonex soil has a profile similar to the one described as representative of the Lemonex series, but the surface is very stony.

Included with this complex in mapping are areas of Alding soils and soils similar to Lemonex soils except they are 40 to 60 inches deep. These areas make up about 15 percent of the mapping unit.

Runoff is rapid, and the hazard of erosion is high. Capability unit VIIs. Rock outcrop is not placed in a woodland group, range site, or wildlife group. The Lemonex soil is in woodland group 4x2 and wildlife group 5. Lithic Xerochrepts are in Mahogany Rockland range site and wildlife group 5.

Rockly Series

The Rockly series consists of well drained soils that formed in loess, ash, and colluvium weathered from basalt on uplands. Slopes are 2 to 70 percent. Elevation is 3,200 to 4,800 feet. The vegetation is bluebunch wheatgrass, Sandberg bluegrass, and low sagebrush. The average annual precipitation is 14 to 20 inches, the average annual air temperature is 45° to 49° F, and the frost free period is 90 to 110 days.

In a representative profile the surface layer is dark brown extremely stony loam about 4 inches thick. The subsoil is dark reddish brown very cobbly clay loam about 4 inches thick. Depth to basalt bedrock is about 8 inches. The soil is neutral throughout its profile.

Permeability is moderate, available water capacity is 0.5 inch to 1.5 inches, and the water supplying capacity is 1 inch to 4 inches. Effective rooting depth is 5 to 12 inches.

These soils are used for range and wildlife habitat.

Representative profile of Rockly extremely stony loam in an area of Gwin-Rockly complex, 3 to 40 percent slopes, in the SW¼NW¼ section 9, T. 12 S., R. 27 E.:

A1—0 to 4 inches; dark brown (7.5YR 3/2) extremely stony loam, brown (7.5YR 4/3) dry; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine irregular pores; 20 percent pebbles, 30 percent cobbles, 10 percent stones; neutral (pH 6.6); clear smooth boundary; 1 to 5 inches thick.

B2—4 to 8 inches; dark reddish brown (5YR 3/3) very cobbly clay loam, reddish brown (5YR 4/3) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine continuous pores; 20 percent pebbles, 30 percent cobbles, 10 percent stones; neutral (pH 6.8); abrupt smooth boundary; 3 to 8 inches thick.

R—8 inches; basalt bedrock.

Depth to bedrock is 5 to 12 inches. The material in the profile is 35 to 75 percent rock fragments. Hue ranges from 10YR to 5YR. In the A1 horizon value is 2 or 3 moist and 4 or 5 dry, and chroma is 2 or 3 moist or dry. In the B2 horizon value is 3 or 4 moist and 4 or 5 dry, and chroma is 3 or 4 moist or dry.

37D—Rockly extremely stony loam, 2 to 20 percent slopes. This soil is on ridgetops and side slopes on uplands. Areas range from 100 to about 250 acres in size.

Included with this soil in mapping are areas of Gwin, Wrightman, and Waterbury soils, and Rock outcrop. These areas make up as much as 15 percent of the mapping unit.

Runoff is slow to medium, and the hazard of erosion is moderate. Capability unit VIIs; Scabland range site; wildlife group 4.

Ruddley Series

The Ruddley series consists of well drained soils that formed in colluvium weathered from metavolcanic rock on uplands. Slopes are 5 to 50 percent. Elevation is 4,000 to 5,500 feet. The vegetation is ponderosa pine, Douglas-fir, snowberry, pinegrass, and elk sedge. The average annual precipitation is 17 to 24 inches, the average annual air temperature is 41° to 45° F, and the frost free period is 30 to 90 days.

In a representative profile the surface layer is very dark grayish brown and dark brown loam about 8 inches thick. The upper 5 inches of the subsoil is dark brown clay loam, and the lower 5 inches is dark yellowish brown clay loam. Depth to partly consolidated bedrock is about 18 inches. The upper part of the surface layer is medium acid, and the lower part of it is slightly acid. The subsoil is neutral.

Permeability is moderately slow, available water capacity is 2 to 4 inches, and the water supplying capacity is 9 to 12 inches. Effective rooting depth is 12 to 20 inches.

These soils are used for timber, grazing, and wildlife habitat.

Representative profile of Ruddley loam in an area of Ruddley-Rock outcrop complex, 5 to 40 percent slopes, about 11 miles northeast of Prairie City in the NE¼ NW¼ section 17, T. 12 S., R. 34 E.:

A11—0 to 4 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate very fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; 5 percent pebbles; medium acid (pH 6.0); abrupt smooth boundary; 3 to 6 inches thick.

A12—4 to 8 inches; dark brown (10YR 3/3) loam, brown (10YR 5/3) dry; weak medium subangular blocky structure;

slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; 5 percent pebbles; slightly acid (pH 6.2); clear wavy boundary; 3 to 6 inches thick.

B21t—8 to 13 inches; dark brown (10YR 3/3) clay loam, yellowish brown (10YR 5/4) dry; weak medium subangular blocky structure; hard, firm, sticky and plastic; common fine roots; many very fine tubular pores; few thin clay films on peds; 10 percent pebbles; neutral (pH 6.6); clear wavy boundary; 4 to 8 inches thick.

B22t—13 to 18 inches; dark yellowish brown (10YR 4/4) clay loam; yellowish brown (10YR 5/4) dry; weak medium subangular blocky structure; hard, firm, sticky and plastic; few fine roots; many very fine tubular pores; common thin clay films on peds; 15 percent pebbles; neutral (pH 6.6); abrupt wavy boundary; 0 to 5 inches thick.

IICr—18 to 24 inches; fractured partly consolidated metavolcanic bedrock.

Depth to partly consolidated metavolcanic rock is 12 to 20 inches. The material in the profile is medium acid to neutral. Hue is 10YR or 7.5YR. The content of pebbles is 10 to 30 percent. In the A1 horizon value is 2 or 3 moist and 4 or 5 dry. Chroma is 2 or 3. In the B2t horizon value is 3 or 4 moist and 4 or 5 dry. Chroma is 3 or 4. The B2t horizon is heavy loam or light clay loam.

38E—Ruddley loam, 5 to 40 percent slopes. This mapping unit is about 60 percent Ruddley loam and 20 percent soils similar to Ruddley loam, but they are 20 to 40 inches deep to partly consolidated bedrock. This mapping unit has north facing slopes. These soils are in a random pattern throughout the mapping unit. The profile of the Ruddley soil is similar in morphology to the one described as representative of the Ruddley series.

Included with these soils in mapping are areas of Hankins, Lemonex, and Alding soils. These areas make up about 20 percent of the mapping unit.

Runoff is medium to rapid, and the hazard of erosion is moderate to severe. Capability unit VIe; woodland group 4d2; wildlife group 5.

39E—Ruddley-Rock outcrop complex, 5 to 40 percent slopes. This complex is about 50 percent Ruddley loam, about 20 percent Rock outcrop, and about 15 percent Lithic Xerochrepts, which are very gravelly or very cobbly loams or clay loams about 3 to 15 inches deep to bedrock. It has generally south facing slopes. The Rock outcrop and the Lithic Xerochrepts are near ridgetops, on convex slopes, and as narrow bands at right angles to the slope. The Ruddley soil is between and around areas of Rock outcrop and Lithic Xerochrepts. It has the profile described as representative of the Ruddley series.

Included with this complex in mapping are areas of clay soils 12 to 20 inches deep and soils similar to Ruddley soils but they are 20 to 40 inches deep. These areas make up about 15 percent of the mapping unit.

Runoff is medium, and the hazard of erosion is moderate to high. Capability unit VIIs. The Ruddley soil is in woodland group 4d1 and wildlife group 5. Rock outcrop is not placed in a woodland group, range site, or wildlife group. Lithic Xerochrepts are in Mahogany Rockland range site and wildlife group 5.

Simas Series

The Simas series consists of well drained soils on uplands. The upper part of these soils formed in loess and colluvium, and the lower part formed in unconsolidated, waterlaid sediment. Slopes are 5 to 65 percent. Elevation is 2,100 to 4,000 feet. The vegetation is bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. The average annual precipitation is 10 to 14 inches, the average annual air temperature is 45° to 50° F, and the frost free period is 90 to 150 days.

In a representative profile the surface layer is very dark grayish brown very stony clay loam about 5 inches thick. The upper 9 inches of the subsoil is dark brown clay, and the lower 13 inches is dark yellowish brown, calcareous clay and gravelly clay. The substratum is dark yellowish brown, calcareous gravelly clay 33 inches or more thick.

Permeability is slow, available water capacity is 6 to 9 inches, and the water supplying capacity is 8 to 12 inches. Effective rooting depth is 24 to 36 inches.

These soils are used mainly for range and wildlife habitat. Small areas are in dryfarmed crops.

Representative profile of Simas very stony clay loam, 8 to 40 percent south slopes, about 15 miles west of Mt. Vernon, ⅓ mile up the Marks Creek Road, in SW¼SW¼ section 7, T. 13 S., R. 28 E.:

A1—0 to 5 inches; grayish brown (10YR 5/2) very stony clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium platy structure; slightly hard, friable, sticky, plastic; many very fine and fine roots; many very fine pores; 15 percent pebbles, 5 percent cobbles, 5 percent stones; 2 percent of surface covered with stones; mildly alkaline (pH 7.8); abrupt smooth boundary; 4 to 10 inches thick.

IIB21t—5 to 14 inches; brown (10YR 5/3) clay; dark brown (10YR 3/3) moist; moderate fine and medium prismatic structure parting to strong medium blocky; extremely hard, very firm, very sticky, very plastic; many very fine roots; few very fine pores; continuous thin clay films on pressure faces; 2 percent pebbles; moderately alkaline (pH 8.3); clear wavy boundary; 5 to 12 inches thick.

IIB22t—14 to 21 inches; yellowish brown (10YR 5/4) clay, dark yellowish brown (10YR 3/4) moist; weak medium prismatic structure parting to strong medium blocky; extremely hard, very firm, very sticky, very plastic; common very fine roots; few very fine pores; continuous thin clay films or pressure faces; 2 percent cobbles; strongly effervescent and common white lime spots; strongly alkaline (pH 8.6); clear wavy boundary; 3 to 9 inches thick.

IIB3ca—21 to 27 inches; yellowish brown (10YR 5/4) gravelly clay, dark yellowish brown (10YR 3/4) moist; moderate medium

subangular blocky structure; very hard, firm, sticky, very plastic; few very fine roots; many very fine pores; 20 percent pebbles; 5 percent cobbles; many white lime spots; strongly effervescent throughout; strongly alkaline (pH 8.5); clear wavy boundary; 4 to 18 inches thick.

IICca—27 to 60 inches; light yellowish brown (10YR 6/4) gravelly clay, dark yellowish brown (10YR 4/4) moist; massive; very hard, firm, sticky, very plastic; many very fine pores; 20 percent pebbles; 15 percent cobbles, 5 percent stones; many white lime seams as much as ¼ inch wide; strongly effervescent; strongly alkaline (pH 8.5).

Depth to soft rock ranges from 40 to more than 60 inches. Depth to hard rock is 60 inches or more. The percentage of the A horizon covered with stones ranges from 0 to 15 percent. The A horizon is clay loam or very stony clay loam. The content of coarse fragments in the B horizon ranges from 0 to 35 percent. The lower part of the B horizon and the upper part of the C horizon are weakly calcareous to strongly calcareous. The C horizon ranges from clay loam to clay. It is 20 to 30 percent rock fragments.

40E—Simas clay loam, 8 to 30 percent south slopes. Areas of this soil range from 100 to about 400 acres in size. This soil has a profile similar to the one described as representative of the series, but the surface layer has few or no stones.

Included with this soil in mapping are areas of Lickskillet, Day, Tub, and very stony Simas soils. These areas make up as much as 15 percent of the mapping unit.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. Capability unit VIe; Droughty South Exposure range site; wildlife group 3.

41E—Simas very stony clay loam, 8 to 40 percent south slopes. Areas of this soil range from 100 to about 1,000 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Lickskillet, Day, and Tub soils. These areas make up as much as 15 percent of the mapping unit.

Runoff is medium to rapid, and the hazard of erosion is moderate to severe. Capability unit VIIs; Droughty South Exposure range site; wildlife group 3.

42E—Simas-Day complex, 5 to 40 percent slopes. This complex is about 35 to 45 percent Simas very stony clay loam, 5 to 40 percent slopes, and 35 to 45 percent Day clay, 5 to 40 percent slopes. Both soils have south facing slopes. The Day soil has the profile described as representative of the Day series.

Included with this complex in mapping are areas of Lickskillet and Tub soils and Badland. These areas make up as much as 20 percent of the mapping unit.

Runoff is moderate to rapid, and the hazard of erosion is moderate to high. Capability unit VIIs; Droughty South Exposure range site; wildlife group 3.

43F—Simas-Badland association, very steep. This association (fig. 3) is about 55 percent Simas very stony clay loam, 40 to 65 percent slopes, and about 25 percent Badland, 40 to 85 percent slopes. Both components have south facing slopes.

Included with this association in mapping are areas of Rock outcrop, Lickskillet soils, and Day soils. These areas make up about 20 percent of the mapping unit.

Runoff is rapid, and the hazard of erosion is high. The Simas soil is in capability unit VIIs, Droughty South Exposure range site, and wildlife group 3. Badland is in capability unit VIIIe. It is not placed in a range site or wildlife group.

44E—Simas-Tub association, steep. This association is about 35 to 45 percent Simas very stony clay loam, 5 to 40 percent slopes, and about 35 to 45 percent Tub clay loam, 20 to 40 percent north slopes. The Simas soil has south facing slopes and is in areas that range from 10 to about 50 acres in size. The Tub soil has north facing slopes and is in areas that range from 10 acres to about 100 acres in size. The association is in areas that range from 100 to about 1,000 acres in size. The profile of the Tub soil is similar in morphology to the one described as representative of the Tub series.

Included with this association in mapping are areas of Rock outcrop, Lickskillet soils, and Day soils. These areas make up about 20 percent of the mapping unit.

Runoff is moderate to rapid, and the hazard of erosion is moderate to high. The Simas soil is in capability unit VIIs, Droughty South Exposure range site, and wildlife group 3. The Tub soil is in capability unit VIIs, North Exposure range site, and wildlife group 4.

Snell Series

The Snell series consists of well drained soils on uplands. They formed in a mixture of loess and basaltic colluvium over basalt bedrock. Slopes are 15 to 70 percent. Elevation is 3,200 to 4,800 feet. The vegetation is bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. The average annual precipitation is 15 to 20 inches, the average annual air temperature is 42° to 45°F, and the frost free period is 60 to 95 days.

In a representative profile the surface layer is very dark brown very stony loam about 10 inches thick. The upper 8 inches of the subsoil is dark brown stony heavy clay loam, and the lower 5 inches is dark brown very stony clay loam. Depth to basalt bedrock is about 23 inches. The soil is neutral throughout its profile.

Permeability is moderately slow, available water capacity is 2 to 5 inches, and the water supplying capacity is 7 to 14 inches. Effective rooting depth is 20 to 40 inches.

These soils are used for range and wildlife habitat.

Representative profile of Snell very stony loam in an area of Snell-Anatone complex, 15 to 40 percent north slopes, in the SE¼NW¼ section 16, T. 12 S., R. 27 E.:

A11—0 to 7 inches; very dark brown (10YR 2/2) very stony loam, dark grayish brown (10YR 4/2) dry; weak very fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; many fine irregular pores; 10 percent pebbles, 5 percent cobbles; 5 percent stones; neutral (pH 6.8); clear smooth boundary; 2 to 8 inches thick.

A12—7 to 10 inches; very dark grayish brown (10YR 3/2) cobbly clay loam, dark

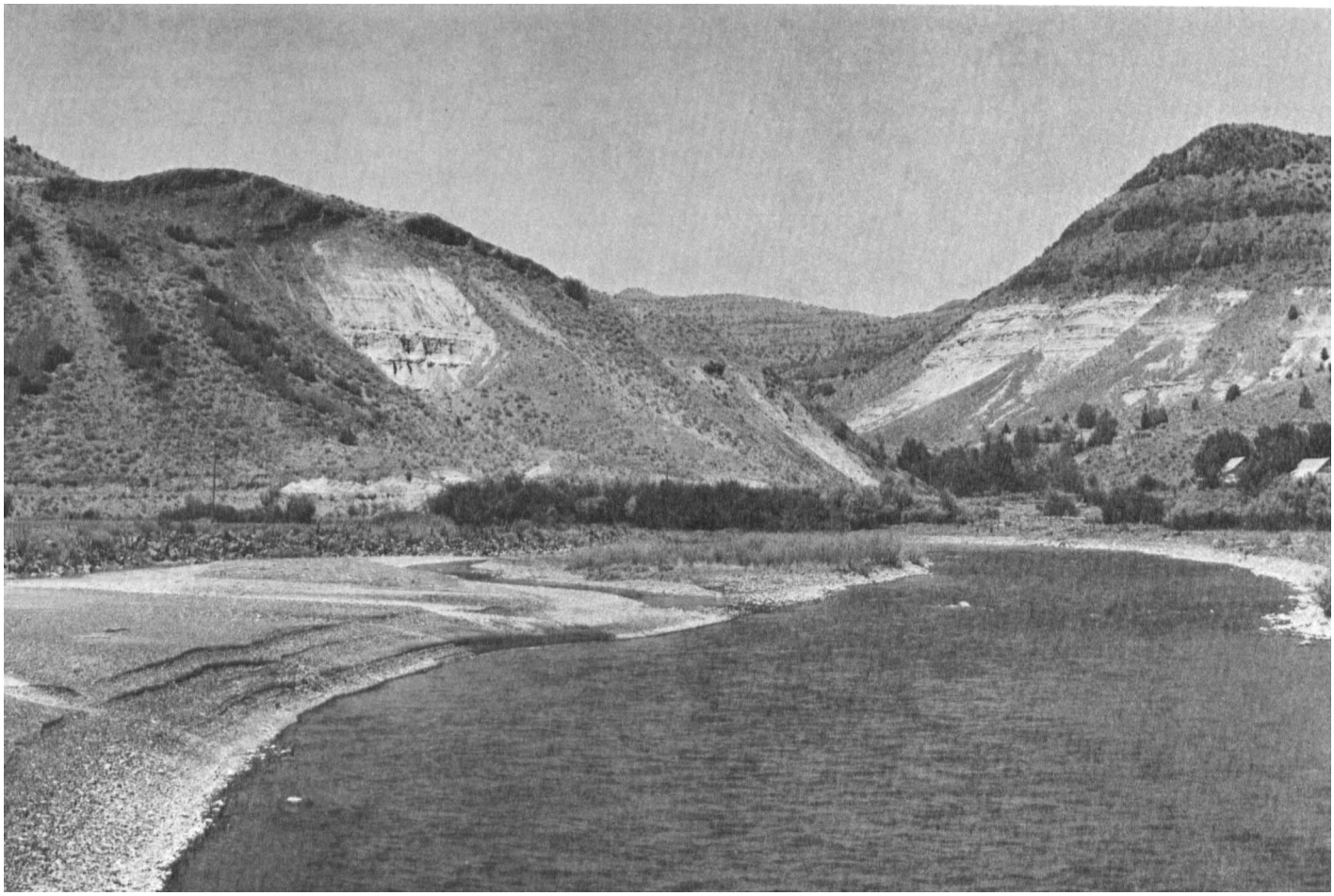

Figure 3.—**Simas-Badland association, very steep, on the lower part of the side slopes and Lickskillet-Rock outcrop complex, 20 to 70 percent slopes, on the upper part of the side slopes.**

grayish brown (10YR 4/2) dry; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many very fine continuous pores; 15 percent pebbles, 10 percent cobbles; neutral (pH 6.8); clear smooth boundary; 3 to 6 inches thick.

B21t—10 to 18 inches; dark brown (10YR 3/3) stony heavy clay loam, brown (10YR 5/3) dry; moderate fine subangular blocky structure; hard, firm, sticky and plastic; common fine roots; few fine and many very fine continuous pores; thin continuous clay films on ped faces; 10 percent pebbles, 15 percent cobbles, 10 percent stones; neutral (pH 6.8); clear smooth boundary; 6 to 15 inches thick.

B22t—18 to 23 inches; dark brown (10YR 3/3) very stony heavy clay loam, brown (10YR 5/3) dry; moderate fine subangular blocky structure; hard, firm, sticky and plastic; common fine roots; common very fine continuous pores; thin patchy clay films on ped faces; 10 percent pebbles, 10 percent cobbles, 40 percent stones; neutral (pH 6.8); abrupt wavy boundary; 4 to 15 inches thick.

R—23 inches; basalt bedrock.

Depth to basalt is 20 to 40 inches. In the A1 horizon value is 2 or 3 moist and 3 or 4 dry, and chroma is 1 or 2 moist or dry. The A1 horizon is 10 to 25 percent stones and cobbles. In the B2t horizon, hue is 10YR or 7.5YR, value is 3 or 4 moist and 4 or 5 dry, and chroma is 2 or 3. The B2t horizon is 35 to 85 percent rock fragments.

45E—Snell very stony loam, 15 to 40 percent north slopes. This soil is on uplands. It has a profile similar in morphology to the one described as representative of the series. Areas range from 100 to about 400 acres in size.

Included with this soil in mapping are areas of Anatone soils, Gwin soils, and Rock outcrop. These soils make up as much as 15 percent of the mapping unit.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. Capability unit VIIs; North Exposure range site; wildlife group 4.

46E—Snell-Anatone complex, 15 to 40 percent north slopes. This complex is about 50 percent Snell very stony loam and about 30 percent Anatone extremely

stony loam. It is on uplands in areas underlain by several different, nearly exposed basalt flows. Each soil is in small, elongated areas roughly at right angles to the slope. The Anatone soil is mainly in areas that are underlain by the smooth upper surface of the basalt flows. The Snell soil is in areas that are underlain by the eroding edge of the basalt flows. The Snell soil has the profile described as representative of the Snell series.

Included with this complex in mapping are areas of Rock outcrop, Gwin soils, and very stony soils 5 to 10 inches deep. These areas make up as much as 15 percent of the mapping unit.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. Capability unit VIIs. Snell soil in North Exposure range site and wildlife group 4. Anatone soil in Scabland range site and wildlife group 4.

46F—Snell-Anatone complex, 40 to 70 percent north slopes. This complex is about 40 percent Snell very stony loam and about 40 percent Anatone extremely stony loam. It is on uplands in areas underlain by several different, nearly exposed basalt flows. Each soil is in small elongated areas roughly at right angles to the slope. The Anatone soil is mainly in areas underlain by the smooth upper surface of the basalt flows. The Snell soil is in areas that are underlain by the eroding edge of the basalt flows.

Included with this complex in mapping are areas of Rock outcrop, Basalt rims, very stony soils 5 to 10 inches deep, and very stony Gwin soils. Each of these areas make up about 5 percent of the mapping unit.

Runoff is rapid, and the hazard of erosion is high. Capability unit VIIs. The Snell soil is in North Exposure range site and wildlife group 4. The Anatone soil is in Scabland range site and wildlife group 4.

Top Series

The Top series consists of well drained soils that formed in loess and colluvium weathered from basalt on uplands. Slopes are 15 to 65 percent. Elevation is 3,500 to 5,000 feet. The vegetation is ponderosa pine, Douglas-fir, white fir, pinegrass, and elk sedge. The average annual precipitation is 17 to 24 inches, the average annual air temperature is 40° to 45°F, and the frost free period is 30 to 80 days.

In a representative profile the surface layer is very dark grayish brown silt loam about 5 inches thick. The upper 16 inches of the subsoil is dark brown silty clay loam and light silty clay, the next 6 inches is dark brown gravelly light clay, and the lower 9 inches is dark brown light clay. The substratum is dark yellowish brown clay loam about 9 inches thick. Depth to basalt bedrock is about 45 inches.

Permeability is moderately slow, available water capacity is 8 to 12 inches, and the water supplying capacity is 13 to 17 inches. Effective rooting depth is 60 inches or more.

These soils are used mainly for timber and wildlife habitat.

Representative profile of Top silt loam, 15 to 35 percent slopes, in the NW¼SW¼ section 30, T. 11 S., R. 28 E.:

A1—0 to 5 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; moderate very fine granular structure; slightly hard, loose, slightly sticky and slightly plastic; many very fine and fine roots; many fine irregular pores; neutral (pH 6.6); abrupt smooth boundary; 3 to 8 inches thick.

B1—5 to 11 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; moderate fine subangular blocky structure; hard, friable, slightly sticky and plastic; many very fine and fine roots; many fine irregular pores; neutral (pH 6.8); clear smooth boundary; 0 to 8 inches thick.

B21t—11 to 21 inches; dark brown (7.5YR 3/3) light silty clay, brown (7.5YR 4/3) dry; moderate medium subangular blocky structure; very hard, firm, very sticky and very plastic; few fine roots; many fine and medium continuous pores; common moderately thick clay films on ped faces; neutral (pH 6.8); clear smooth boundary; 8 to 15 inches thick.

B22t—21 to 27 inches; dark brown (7.5YR 3/4) gravelly light clay, brown (7.5YR 5/3) dry; moderate medium subangular blocky structure; very hard, firm, sticky and plastic; few fine roots; many very fine continuous pores; common moderately thick clay films on ped faces; 25 percent pebbles; neutral (pH 6.8); clear smooth boundary; 0 to 10 inches thick.

B3t—27 to 36 inches; dark brown (7.5YR 3/4) light clay, brown (7.5YR 5/3) dry; weak medium subangular blocky structure; hard, friable, sticky and plastic; few fine roots; many very fine continuous pores; common moderately thick clay films on ped faces; neutral (pH 7.0); clear smooth boundary; 0 to 12 inches thick.

C—36 to 45 inches; dark yellowish brown (10YR 4/4) clay loam, yellowish brown (10YR 5/4) dry; massive; hard, friable, sticky and plastic; few fine roots; many very fine continuous pores; common moderately thick clay films in pores; neutral (pH 7.0); 4 to 24 inches or more thick.

R—45 inches; basalt bedrock.

Depth to basalt bedrock ranges from 40 to 60 inches. Hue is 10YR or 7.5YR. In the A1 horizon value is 2 or 3 moist and 4 or 5 dry. Chroma is 2 or 3.

47E—Top silt loam, 15 to 35 percent slopes. This soil has north facing slopes. It has the profile described as representative of the series. Areas range from 100 to about 500 acres in size.

Included with this soil in mapping are areas of McGarr soils, deep soils that have a volcanic ash surface layer, Rock outcrop, and Anatone soils. These areas make up as much as 15 percent of the mapping unit.

Runoff is medium to rapid, and the hazard of erosion is high. Capability unit VIe; woodland group 3o3; wildlife group 5.

47F—Top silt loam, 35 to 65 percent slopes. This soil has north facing slopes. Areas range from 100 to about 300 acres in size.

Included with this soil in mapping are areas of McGarr soils, deep soils that have a volcanic ash surface layer, Rock outcrop, and Anatone soils. These areas make up about 15 percent of the mapping unit.

Runoff is rapid, and the hazard of erosion is high. Capability unit VIIe; woodland group 3r1; wildlife group 5.

Tub Series

The Tub series consists of well drained soils that formed in fine textured old calcareous sediment on uplands. Slopes are 3 to 65 percent. Elevation is 2,100 to 4,000 feet. The vegetation is bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, and related forbs. The average annual precipitation is 11 to 14 inches, the average annual air temperature is 45° to 48° F, and the frost free period is 90 to 120 days.

In a representative profile the surface layer is black and very dark brown clay loam about 8 inches thick. The upper 15 inches of the subsoil is dark brown clay, and the lower 16 inches is dark yellowish brown, calcareous silty clay loam. The substratum is brown calcareous silty clay loam 21 inches or more thick. The surface layer and upper part of the subsoil are neutral, and the lower part of the subsoil and substratum are moderately alkaline.

Permeability is slow, available water capacity is 3 to 7 inches, and the water supplying capacity is 6 to 9 inches. Effective rooting depth is 20 to 40 inches.

This soil is used mainly for range and wildlife habitat. Small areas are used for dryfarmed small grain.

Representative profile of Tub clay loam, 20 to 40 percent north slopes, in the SW¼NE¼ section 10, T. 14 S., R. 30 E.:

A11—0 to 2 inches; black (10YR 2/1) clay loam, gray (10YR 5/1) dry; weak thin platy structure parting to moderate very fine granular; slightly hard, friable, sticky and plastic; many very fine and common fine roots; common fine discontinuous pores; neutral (pH 6.6); clear smooth boundary; 1 to 4 inches thick.

A12—2 to 8 inches; very dark brown (10YR 2/2) clay loam, gray (10YR 5/1) dry; moderate medium subangular blocky structure; slightly hard, friable, sticky and plastic; many very fine and common fine roots; common very fine and fine discontinuous pores; neutral (pH 6.6); abrupt smooth boundary; 5 to 10 inches thick.

B21t—8 to 18 inches; dark brown (10YR 3/3) clay, brown (10YR 4/3) dry; moderate medium prismatic structure parting to strong fine blocky structure; very hard, firm, very sticky and very plastic; many very fine and common fine roots along ped faces; many very fine continuous pores; continuous moderately thick clay films on ped faces; neutral (pH 6.8); clear smooth boundary; 5 to 12 inches thick.

B22t—18 to 23 inches; dark brown (10YR 3/3) clay, brown (10YR 5/3) dry; moderate coarse subangular blocky structure; very hard, firm, very sticky and very plastic; few fine and common very fine roots; many very fine and fine continuous pores; many thin clay films on ped faces; neutral (pH 7.2); clear wavy boundary; 0 to 9 inches thick.

B31ca—23 to 31 inches; dark yellowish brown (10YR 4/4) silty clay loam, pale brown (10YR 6/3) dry; moderate fine subangular blocky structure; slightly hard, sticky and plastic; common very fine and fine roots; many very fine and fine continuous pores; few thin clay films on ped faces; strongly effervescent in spots, lime segregated in fine irregular soft masses; moderately alkaline (pH 8.2); clear smooth boundary; 0 to 10 inches thick.

B32ca—31 to 39 inches; dark yellowish brown (10YR 4/4) silty clay loam, light yellowish brown (10YR 6/4) dry; weak fine subangular blocky structure; hard, friable, sticky and plastic; few very fine and fine roots; many very fine and fine continuous pores; strongly effervescent, lime segregated in common fine irregular soft masses and in fine filaments; moderately alkaline (pH 8.2); clear smooth boundary; 0 to 10 inches thick.

Cca—39 to 60 inches; brown (10YR 4/3) silty clay loam, pale brown (10YR 6/3) dry; massive; hard, friable, sticky and plastic; few very fine roots; common very fine continuous pores; strongly effervescent, lime segregated in common fine irregular soft masses; moderately alkaline (pH 8.2).

Depth to weathered bedrock is 40 to 60 inches. Depth to hard bedrock is more than 60 inches. The content of rock fragments in the profile ranges from 0 to 35 percent. In the A1 horizon value is 1 or 2 moist and 4 or 5 dry. Chroma is 1 or 2. In the B2t horizon value is 3 or 4 moist and 4 or 5 dry. Chroma is 2 or 3 moist or dry.

48E—Tub clay loam, 20 to 40 percent north slopes. This soil is on uplands. It has the profile described as representative of the series. Areas range from 100 to about 400 acres in size.

Included with this soil in mapping are areas of Simas soils and clay soils underlain by bedrock at a depth of 20 to 40 inches. These areas make up as much as 15 percent of the mapping unit.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. Capability unit VIe; North Exposure range site; wildlife group 4.

48F—Tub clay loam, 40 to 65 percent north slopes. This soil is on uplands. Areas range from 100 to about 500 acres in size.

Included with this soil in mapping are areas of Simas soils, soils underlain by bedrock at a depth of

20 to 40 inches, and Badland. These areas make up as much as 15 percent of the mapping unit.

Runoff is rapid, and the hazard of erosion is high. Capability unit VIIe; North Exposure range site; wildlife group 4.

49D—Tub stony clay loam, 3 to 20 percent slopes. This soil is on uplands. It has a profile similar to the one described as representative of the series, but the surface layer is stony. Areas range from 20 to about 100 acres in size.

Included with this soil in mapping are areas of Simas soils, clay soils 20 to 40 inches to bedrock, and very stony Tub soils. These areas make up as much as 15 percent of the mapping unit.

Runoff is slow to medium, and the hazard of erosion is slight to moderate. Capability unit IVe–2 dryland; Rolling Hills range site; wildlife group 4.

Ukiah Series

The Ukiah series consists of well drained soils that formed in colluvium weathered from volcanic tuff. Slopes are 2 to 50 percent. Elevation is 3,000 to 4,600 feet. The vegetation is Idaho fescue, bluebunch wheatgrass, and Sandberg bluegrass. The average annual precipitation is 15 to 20 inches, the average annual air temperature is 47° to 49° F, and the frost free period is 90 to 110 days.

In a representative profile the surface layer is black very stony silty clay loam about 6 inches thick. The upper 9 inches of the subsoil is very dark brown stony clay, and the lower 11 inches is dark brown clay. The substratum is brown, calcareous clay loam about 4 inches thick. Depth to volcanic tuff is about 30 inches. The surface layer and the upper part of the subsoil are neutral, and the lower part of the subsoil and the substratum are moderately alkaline.

Permeability is very slow, available water capacity is 2.5 to 6 inches, and the water supplying capacity is 6 to 12 inches. Effective rooting depth is 20 to 40 inches.

This soil is used for range and wildlife habitat. Small areas are used for dryfarmed small grain.

Representative profile of Ukiah very stony silty clay loam, 3 to 15 percent slopes, 25 feet south of U.S. Highway 26 in the SW¼SE¼ section 6, T. 13 S., R. 34 E.:

A1—0 to 6 inches; black (10YR 2/1) very stony silty clay loam, dark gray (10YR 4/1) dry; moderate fine granular structure; hard, friable, sticky and plastic; many very fine roots; many fine irregular pores; 5 percent stones, 10 percent cobbles; neutral (pH 6.8); abrupt smooth boundary; 5 to 12 inches thick.

B21t—6 to 15 inches; very dark brown (10YR 2/2) very stony clay, dark grayish brown (10YR 4/2) dry; moderate medium prismatic structure; very hard, firm, very sticky and very plastic; common very fine roots; common very fine continuous pores; few slickensides; 5 percent stones, 10 percent cobbles; neutral (pH 6.8); abrupt wavy boundary; 4 to 12 inches thick.

B22t—15 to 22 inches; dark brown (10YR 3/3) clay, brown (10YR 5/3) dry; weak medium prismatic structure parting to moderate medium subangular blocky; very hard, firm, very sticky and very plastic; few very fine roots; common very fine continuous pores; few slickensides and pressure faces; neutral (pH 7.0); clear wavy boundary; 5 to 12 inches thick.

B3t—22 to 26 inches; dark brown (10YR 3/3) clay, brown (10YR 5/3) dry; weak medium subangular blocky structure; very hard, firm, very sticky and very plastic; few very fine roots; common very fine continuous pores; common pressure faces; weakly calcareous; moderately alkaline (pH 8.0); clear wavy boundary; 0 to 6 inches thick.

C1ca—26 to 30 inches; brown (10YR 4/3) clay loam, pale brown (10YR 6/3) dry; massive; hard, firm, sticky and plastic; few very fine roots; common very fine continuous pores; many white lime streaks and splotches; strongly calcareous; moderately alkaline (pH 8.2); abrupt wavy boundary; 0 to 6 inches thick.

C2r—30 to 41 inches; semiconsolidated very pale brown volcanic tuff; can be dug with spade with difficulty.

Depth to the volcanic tuff is 20 to 40 inches. In the A1 horizon value is 2 or 3 moist, and chroma is 1 or 2. In the upper part of the B2t horizon, value is 4 or 5 dry and 2 or 3 moist. The B2t horizon is 15 to 35 percent rock fragments.

50B—Ukiah stony silty clay loam, 2 to 8 percent slopes. This soil is on uplands. It has a profile similar to the one described as representative of the series, but the surface layer is stony. Areas range from 25 to about 150 acres in size.

Included with this soil in mapping are areas of Gwin and Waterbury soils. These areas make up as much as 15 percent of the mapping unit.

Runoff is medium, and the hazard of erosion is moderate. Capability unit IVe–2 dryland; Moist Rolling Hills range site; wildlife group 4.

51C—Ukiah very stony silty clay loam, 3 to 15 percent slopes. This soil is on uplands. It has the profile described as representative of the series. Areas range from 100 to about 300 acres in size.

Included with this soil in mapping are areas of Gwin, Rockly, and Waterbury soils. These areas make up as much as 15 percent of the mapping unit.

Runoff is medium, and the hazard of erosion is moderate. Capability unit VIIs; Moist Rolling Hills range site; wildlife group 4.

52E—Ukiah extremely stony silty clay loam, 15 to 50 percent slopes. This soil is on uplands. It has south facing slopes. It has a profile similar to the one described as representative of the series, but the surface layer is extremely stony. Areas range from 100 to about 1,000 acres in size.

Included with this soil in mapping are areas of Gwin, Rockly, and Waterbury soils. These areas make up as much as 15 percent of the mapping unit.

Runoff is medium to rapid, and the hazard of ero-

sion is moderate to high. Capability unit VIIs; South Exposure range site; wildlife group 4.

Veazie Series

The Veazie series consists of well drained soils that formed in recent alluvium on bottom land. Slopes are 0 to 3 percent. Elevation is 2,400 to 4,200 feet. In uncultivated areas the vegetation is Kentucky bluegrass, willows, and cottonwood trees. The average annual precipitation is 12 to 18 inches, the average annual air temperature is 48° to 51° F, and the frost free period is 90 to 150 days.

In a representative profile the surface layer is black loam about 7 inches thick. The next layer is black loam about 8 inches thick. The upper 6 inches of the substratum is very dark brown loam, and the lower 19 inches or more is very dark brown very gravelly loamy sand. The soil is slightly acid to neutral in the upper part of the profile and is neutral in the lower part.

Permeability is moderate, available water capacity is 3 to 7 inches, and the water supplying capacity is 5 to 10 inches. Effective rooting depth is 20 to 40 inches.

These soils are used for irrigated hay, pasture, range, and wildlife habitat.

Representative profile of Veazie loam, 45 feet northeast of bridge across the John Day River, in the NE¼ section 27, T. 13 S., R. 34 E.:

A1—0 to 7 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine and very fine roots; few medium and common fine and very fine irregular pores; slightly acid (pH 6.4); clear smooth boundary; 6 to 24 inches thick.

AC—7 to 15 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many fine and very fine roots; common fine and very fine tubular pores; neutral (pH 6.6); clear smooth boundary; 0 to 12 inches thick.

C1—15 to 21 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; massive; slightly hard, very friable, slightly sticky and slightly plastic; common fine roots; common fine and very fine continuous pores; 10 percent fine pebbles; neutral (pH 6.6); abrupt smooth boundary; 0 to 20 inches thick.

IIC2—21 to 40 inches; very dark brown (10YR 2/2) very gravelly loamy sand, dark grayish brown (10YR 4/2) dry; single grained; loose, nonsticky and nonplastic; few fine roots; 60 percent pebbles; neutral (pH 6.6).

Depth to the IIC horizon is 20 to 40 inches. The A and AC horizons are very dark brown or black when moist. They are loam or silt loam. The C horizon is very dark grayish brown to very dark brown when moist. The IIC horizon is very gravelly loamy sand or very gravelly sand.

53—Veazie loam. This soil is on bottom lands. Slopes are 0 to 3 percent. Areas range from 10 to about 80 acres in size.

Included with this soil in mapping are areas of Boyce and Dayville soils and very gravelly soils. These areas make up as much as 15 percent of the mapping unit.

Runoff is slow, and the hazard of erosion is slight. Flooding occurs occasionally in winter or early in spring. Capability unit IIIw–1 irrigated; not placed in range site; wildlife group 2.

Venator Series

The Venator series consists of well drained soils that formed in residuum and colluvium weathered from shale. Slopes are 5 to 65 percent. Elevation is 4,000 to 5,000 feet. The vegetation is bluebunch wheatgrass, Sandberg bluegrass, and bitterbrush. The average annual precipitation is 13 to 16 inches, the average annual air temperature is 46° to 48° F, and the frost free period is 50 to 90 days.

In a representative profile the surface layer is very dark grayish brown very shaly loam about 5 inches thick. The subsoil is dark brown very shaly loam about 7 inches thick. Depth to shale bedrock is about 12 inches. The surface layer is slightly acid, and the subsoil is neutral.

Permeability is moderate, available water capacity is 1 inch to 2.5 inches, and the water supplying capacity is 4 to 7 inches. Effective rooting depth is 10 to 20 inches.

These soils are used for range and wildlife habitat.

Representative profile of Venator very shaly loam, 5 to 40 percent slopes, in the SW¼NW¼ section 16, T. 14 S., R. 31 W.:

A1—0 to 5 inches; very dark grayish brown (10YR 3/2) very shaly loam, brown (10YR 5/3) dry; weak very fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine and very fine roots; many fine irregular pores; 55 percent small angular shale pebbles; slightly acid (pH 6.4); clear smooth boundary; 4 to 12 inches thick.

B2—5 to 12 inches; dark brown (10YR 3/3) very shaly loam, brown (10YR 5/3) dry; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; many fine irregular pores; 65 percent small angular shale pebbles; neutral (pH 6.6); abrupt wavy boundary; 4 to 10 inches thick.

R—12 inches; hard and unweathered shale bedrock.

Depth to shale bedrock is 10 to 20 inches. In the A1 horizon value is 2 or 3 moist and 4 or 5 dry. Chroma is 2 or 3. The A1 horizon is 25 to 60 percent pebbles. In the B2 horizon value is 3 or 4 moist and 4 or 5 dry. Chroma is 2 or 3. The B2 horizon is 40 to 80 percent pebbles.

54E—Venator very shaly loam, 5 to 40 percent slopes. This soil is on uplands. It has south facing slopes. It has the profile described as representative of the series. Areas range from 100 to about 1,000 acres in size.

Included with this soil in mapping are areas of Logdell soils, Gwin soils, and Rock outcrop. These areas make up as much as 15 percent of the mapping unit.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. Capability unit VIs; Shrubby South Exposure range site; wildlife group 4.

55F—Venator-Rock outcrop complex, 40 to 65 percent slopes. This complex is about 50 percent Venator very shaly loam and about 30 percent Rock outcrop. It is on uplands. It has south facing slopes. The Rock outcrop is in small areas on ridgetops and convex or nose-point slopes and in narrow bands at right angles to the slope. Venator soils are in small areas between the areas of Rock outcrop.

Included with this complex in mapping are areas of Logdell soils, Gwin soils, and shaly soils 20 to 40 inches to bedrock. These areas make up as much as 20 percent of the mapping unit.

Runoff is rapid, and the hazard of erosion is high. Capability unit VIIs. The Venator soil is in the Shrubby South Exposure range site and wildlife group 4. The Rock outcrop is not placed in a range site or wildlife group.

Waterbury Series

The Waterbury series consists of well drained soils that formed in colluvium weathered mainly from tuff and basalt. Slopes are 3 to 40 percent. Elevation is 3,000 to 4,600 feet. The vegetation is bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, and low sage. The average annual precipitation is 13 to 18 inches, the average annual air temperature is 45° to 50° F, and the frost free period is 80 to 110 days.

In a representative profile the surface layer is black extremely stony silty clay loam about 4 inches thick. The upper 7 inches of the subsoil is black very cobbly clay, and the lower 4 inches is very dark brown very cobbly clay. Depth to basalt bedrock is about 15 inches.

Permeability is very slow, available water capacity is 1 inch to 2.5 inches, and the water supplying capacity is 6 to 9 inches. Effective rooting depth is 12 to 20 inches.

These soils are used for range and wildlife habitat.

Representative profile of Waterbury extremely stony silty clay loam, 3 to 40 percent slopes, in the SW¼ NE¼ section 4, T. 12 S., R. 26 E.:

A1—0 to 4 inches; black (10YR 2/1) extremely stony silty clay loam, dark gray (10YR 4/1) dry; moderate fine granular structure; slightly hard, friable, sticky and plastic; many very fine roots; many very fine irregular pores; 10 percent pebbles, 30 percent cobbles, 20 percent stones; neutral (pH 6.8); abrupt smooth boundary; 3 to 9 inches thick.

B21t—4 to 11 inches; black (10YR 2/1) very cobbly clay, dark gray (10YR 4/1) dry; strong fine and medium subangular blocky structure; extremely hard, very firm, very sticky and very plastic; common very fine roots; many fine continuous pores; many thin clay films in pores; 20 percent pebbles, 40 percent cobbles, 10 percent stones; neutral (pH 6.8); clear wavy boundary; 0 to 8 inches thick.

B22t—11 to 15 inches; very dark brown (10YR 2/2) very cobbly clay, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; extremely hard, very firm, very sticky and very plastic; common very fine roots; many fine continuous pores; many thin clay films in pores; 20 percent pebbles, 40 percent cobbles, 10 percent stones; neutral (pH 6.8); abrupt wavy boundary; 4 to 14 inches thick.

R—15 inches; basalt bedrock.

Depth to bedrock is 12 to 20 inches. The content of rock fragments in the profile ranges from 35 to 80 percent. They are mainly stones and cobbles. In the A1 horizon value is 2 to 4 moist, and chroma is 1 or 2 moist or dry. In the B2t horizon value is 2 or 3 moist and 4 or 5 dry. Chroma is 2 or 3 moist or dry.

56E—Waterbury extremely stony silty clay loam, 3 to 40 percent slopes. This soil is on uplands. It has south facing slopes. Areas range from 100 to about 600 acres in size.

Included with this soil in mapping are areas of Ukiah, Gwin, and Rockly soils, and Rock outcrop. These areas make up as much as 15 percent of the mapping unit.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. Capability unit VIIs; Deep Scabland range site; wildlife group 4.

Wrightman Series

The Wrightman series consists of well drained soils that formed in colluvium and alluvium from basaltic rock and loess. Slopes are 2 to 25 percent. Elevation is 4,000 to 5,200 feet. The vegetation is bluebunch wheatgrass, Idaho fescue, and big sagebrush. The average annual precipitation is 16 to 25 inches, the average annual air temperature is 42° to 45° F, and the frost free period is 10 to 60 days.

In a representative profile the surface layer is very dark brown loam about 11 inches thick (fig. 4). The upper 10 inches of the subsoil is very dark brown loam, and the lower 4 inches is dark brown loam. Depth to basalt bedrock is about 25 inches.

Permeability is moderate, available water capacity is 3 to 7 inches, and the water supplying capacity is 13 to 16 inches. Effective rooting depth is 20 to 40 inches.

These soils are used for range and wildlife habitat.

Representative profile of Wrightman loam in an area of Wrightman-Anatone complex, 2 to 20 percent slopes, in the NE¼SE¼ section 2, T. 11 S., R. 26 E.:

A11—0 to 5 inches; very dark brown (7.5YR 2/2) loam, brown to dark brown (7.5YR 4/3) dry; moderate very fine granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; 10 percent pebbles; slightly acid (pH 6.5); clear smooth boundary; 3 to 7 inches thick.

A12—5 to 11 inches; very dark brown (7.5YR 2/2) loam, brown to dark brown (7.5YR

Figure 4.—Profile of Wrightman loam underlain by basalt bedrock at a depth of 25 inches.

4/3) dry; moderate very fine granular structure; soft, friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; 5 percent fine pebbles; slightly acid (pH 6.5); clear wavy boundary; 4 to 8 inches thick.

B21—11 to 21 inches; very dark brown (7.5YR 2/3) loam, brown to dark brown (7.5YR 4/3) dry; moderate very fine subangular blocky structure; slightly hard, slightly sticky and slightly plastic; common very fine to medium roots; many very fine irregular pores; slightly acid (pH 6.5); clear wavy boundary; 6 to 15 inches thick.

B22—21 to 25 inches; dark brown (7.5YR 3/2) loam, brown to dark brown (7.5YR 4/3) dry; weak very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and medium roots; many very fine irregular pores; slightly acid (pH 6.5); abrupt smooth boundary; 0 to 15 inches thick.

IIR—25 inches; basalt bedrock.

Depth to basalt bedrock is 20 to 40 inches. Hue ranges from 10YR to 5YR. In the A1 horizon value is 2 or 3 moist and 4 or 5 dry. Chroma is 2 or 3. In the B2 horizon value is 3 or 4 moist and 4 or 5 dry. Chroma is 3 or 4. The B2 horizon is loam or clay loam and is 18 to 30 percent clay.

57D—Wrightman-Anatone complex, 2 to 20 percent slopes. This complex is about 40 percent Wrightman loam and 40 percent Anatone extremely stony loam. The Anatone soil occurs as scabland between and around the Wrightman soil. The Wrightman soil occurs as circular mounds that have a convex surface and are deepest in the center. The mounds are 15 to 40 feet in diameter and about 35 feet apart. The Wrightman soil has the profile described as representative of the Wrightman series.

Included with this complex in mapping are areas of McGarr soils, very stony soils 5 to 10 inches deep, and Rock outcrop. These areas make up as much as 20 percent of the mapping unit.

Runoff is medium, and the hazard of erosion is moderate. Capability unit VIIs. The Wrightman soil is in Shrubby Rolling Hills range site and wildlife group 4. The Anatone soil is in the Scabland range site and wildlife group 4.

Use and Management of the Soils

Described in this section are principles of soil management, capability groups of soils, estimated yields of principal crops, and the management of the soils when used for range, woodland, wildlife habitat, and engineering.

Management Needs[2]

Different soils require different management, and the same soil can require variations in management from year to year or from crop to crop. In the following paragraphs are descriptions of the basic management needs.

Conserving moisture.—Dryland cultivated soils in Grant County, Oregon, Central Part, have limited suitability for crops because of inadequate moisture. Except for small areas used for grain crops, drought tolerant perennial grasses and legumes for hay are the major crops. Crested wheatgrass and ladak or nomad alfalfa are grown at the lower elevations, and intermediate wheatgrass and ladak or nomad alfalfa are grown at higher elevations.

Controlling erosion.—Many soils in the survey area are shallow or moderately deep. Soil erosion limits the capacity of soils to store moisture and supply nutrients. Proper tillage, good irrigation water management, and streambank protection are important erosion control practices.

Plowing on the flood plain should be delayed until the danger of major flooding is past. On upland soils the surface should be left rough or tillage should be delayed until after snowmelt, especially at the higher elevations. Good fertilizing practices, choice of suited plants, and rodent control help maintain the stand of perennial plants. These practices also limit the amount of tillage needed and the time the soil is especially vulnerable to accelerated erosion.

Providing proper irrigation water management.—Sprinkler and surface irrigation are used in the survey area. Most surface irrigation is by wild flooding with heavy, nearly continuous application of water, especially in spring and early in summer.

Good water management is being achieved in most cases by use of sprinkler irrigation (fig. 5). Rough leveling to eliminate pockets, sharp breaks, and other

[2] WILLIAM K. FARRELL, Grant County Agricultural Extension Agent, assisted in preparation of this section.

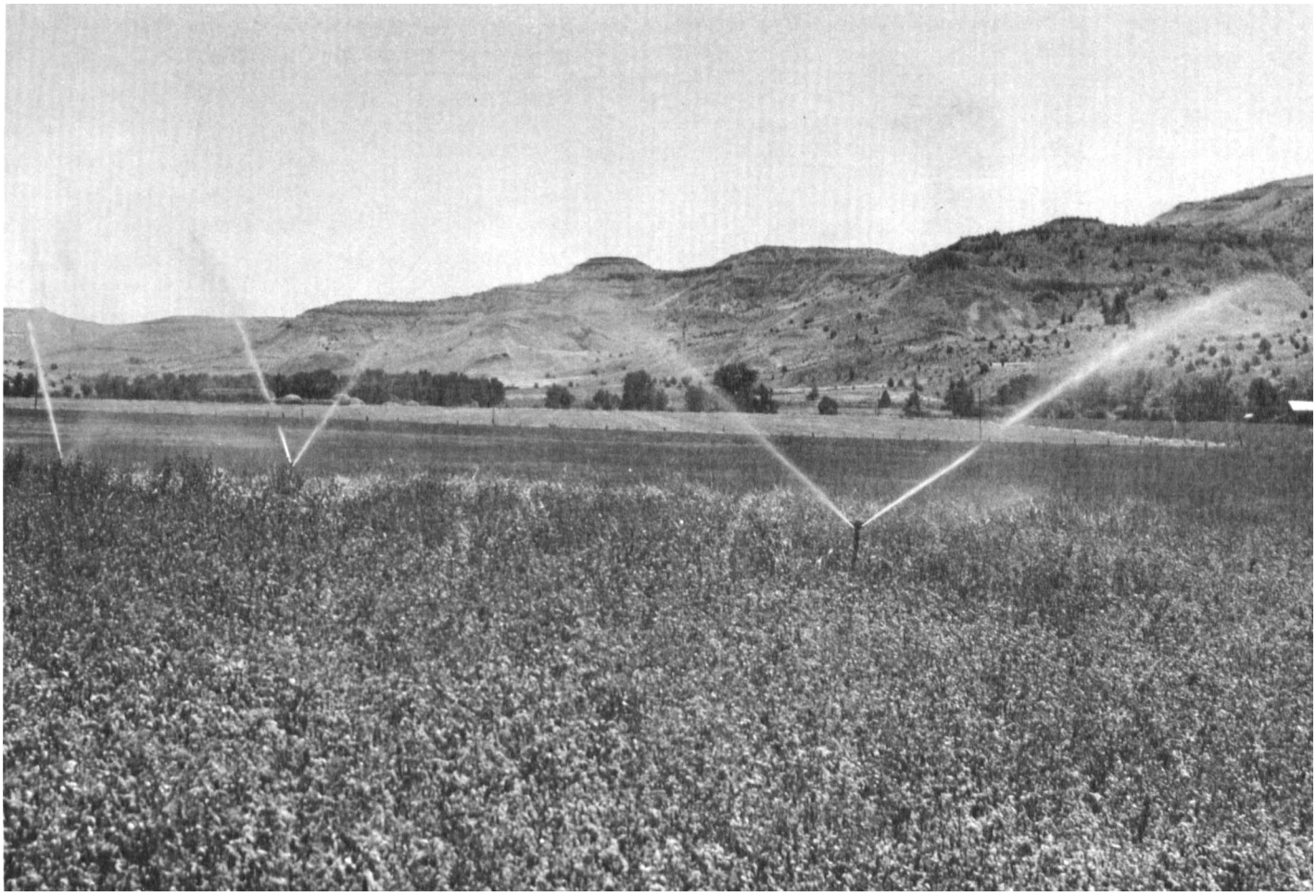

Figure 5.—**Sprinkler irrigation in area of Courtrock loam, 2 to 7 percent slopes.**

irregularities is important in some fields. Proper design and operation are essential. Such soil properties as intake rate, available water capacity, and permeability are important in properly designed systems.

On deep, well drained, nearly level to gently sloping soils, good water management is achieved by surface application on properly leveled fields. If soils are properly leveled, water moves quickly and evenly over the field and wets the root zone to a uniform depth. Properly designed ditches and structures are essential to uniform water distribution. After major leveling, at least some floating and land planning is necessary to eliminate high spots and fill low spots. Thus crops can be irrigated without wasting water. Good practices are to plant recently leveled fields to annual hay or grain crops for 1 or 2 years and to float the fields annually before seeding to perennial crops.

Better water management could be achieved on the areas presently wild flooded by converting many of the well drained soils to sprinkler irrigation, by landleveling the deeper soils, and by a combination of drainage and landleveling other soils. Where such practices are properly carried out, production is frequently doubled and the quality of hay is much improved.

Capability Grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations when they are used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to horticultural crops, or other crops that require special management. This classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, for forest trees, or for engineering purposes.

In the capability system, all kinds of soils are grouped at three levels: capability class, subclass, and unit. These levels are defined in the following paragraphs.

CAPABILITY CLASSES, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations

and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use.
Class II soils have moderate limitations that reduce the choice of plants or require moderate conservation practices.
Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.
Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.
Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.
Class VI soils have severe limitations that make them generally unsuitable for cultivation.
Class VII soils have very severe limitations that make them unsuitable for cultivation.
Class VIII soils and landforms have limitations that nearly preclude their use for commercial plants.

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c,* used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c,* because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use to pasture, range, woodland, wildlife habitat, or recreation.

The capability unit is identified in the description of each soil mapping unit in the section "Descriptions of the Soils." Capability units are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe–1 or IIIe–2.

Management by capability units

In the following pages the capability units in Grant County, Oregon, Central Part, are described and suggestions for the use and management of the soils are given.

The names of soil series represented in a capability unit are given in the description of the capability unit, but this does not mean that all of the soils of a given series appear in the unit. To find all the soils in any given capability unit, refer to the "Guide to Mapping Units" at the back of this survey.

CAPABILITY UNIT IIe–1, IRRIGATED

This capability unit consists of well drained Courtrock and Hack soils. Slopes are 0 to 7 percent. The annual precipitation is 10 to 18 inches, and the frost free period is 100 to 150 days.

Permeability is moderately slow or moderately rapid. Available water capacity is 6 to 11 inches. Typically, roots penetrate to a depth of 40 to more than 60 inches. Runoff is slow or medium, and the hazard of erosion is slight.

The soils in this capability unit are used for irrigated hay and pasture and for wildlife habitat.

Irrigated alfalfa and alfalfa and grass are grown for hay. Some hay is used for aftermath grazing in the fall, but it should be carefully controlled to protect alfalfa vigor. Alfalfa generally needs annual or semiannual sulfur fertilization, and gypsum is generally used as the source of sulfur. Phosphorus is sometimes needed and should be applied according to recommendations based on soil tests. The first cutting should be done at full bud stage, the second at 1/10 to 1/2 bloom stage, and the third 4 to 6 weeks before the first killing frost. The yield from the third cutting is generally low and is frequently used for aftermath grazing.

Irrigation water is available all summer in most years in areas that have older water rights. Adequate irrigation water is generally available until about July 15 in areas that have newer water rights. Sprinkler and wild flooding are two of the methods of irrigation.

Rodents are a serious concern, and control is often necessary to maintain the stand of alfalfa. Perennial weeds are controlled mainly by the use of chemicals.

Irrigated pasture or grain is sometimes grown.

CAPABILITY UNIT IIw–1, IRRIGATED

Dayville silt loam, the only soil in this capability unit, is somewhat poorly drained. Slopes are 0 to 2 percent. The annual precipitation is 12 to 16 inches, and the frost free period is 100 to 150 days.

Permeability is moderate. Available water capacity is 5 to 9 inches. Typically, roots penetrate to a depth of 30 to 36 inches. Runoff is slow, and the hazard of erosion is moderate. Flooding occurs occasionally in winter or early in spring.

The soil in this capability unit is used for irrigated hay and pasture and for wildlife habitat.

Irrigated grass and grass and clover are grown for hay. The hay is generally used for aftermath grazing in the fall. Annual nitrogen fertilization is needed on grass. Sulfur is generally needed, and phosphorus is needed at times if grass and clover are grown together. Phosphorus should be applied according to recommendations based on soil tests. Hay should be cut in the early bloom stage of growth.

Irrigation water is available during summer in most years in areas that have older water rights. Adequate irrigation water is generally available until about July 15 in areas that have newer water rights. Sprinkler, border, and wild flooding are three methods of irrigation.

Irrigated alfalfa for hay is grown in a few areas where adequate artificial drainage systems have been installed.

Perennial weeds are controlled mainly by the use of chemicals.

CAPABILITY UNIT IIw-2, IRRIGATED

Powder silt loam, occasional overflow, the only soil in this capability unit, is well drained. Slopes are 0 to 2 percent. The annual precipitation is 10 to 13 inches, and the frost free period is 130 to 150 days.

Permeability is moderate. Available water capacity is 9 to 12 inches. Typically, roots penetrate to a depth of 50 inches or more. Runoff is slow, and the hazard of erosion is moderate. Flooding occurs occasionally in winter or early in spring.

The soil in this capability unit is used for irrigated hay and pasture, and for wildlife habitat.

Irrigated alfalfa and alfalfa and grass are grown for hay. Some hay is used for aftermath grazing in the fall, but it should be carefully controlled to protect alfalfa vigor. Alfalfa generally needs annual or semiannual sulfur fertilization, and gypsum is generally used as the source of sulfur. Phosphorus is sometimes needed and should be applied according to recommendations based on soil tests. The first cutting should be done at full bud stage, the second at 1/10 to 1/2 bloom stage, and the third 4 to 6 weeks before the first killing frost.

Irrigation water is available all summer in most years in areas that have older water rights. Adequate irrigation water is generally available until about July 15 in areas that have newer water rights. Sprinkler, border, and wild flooding are three of the methods of irrigation.

Rodents are a serious concern, and control is often necessary to maintain the stand. Perennial weeds are controlled mainly by the use of chemicals.

CAPABILITY UNIT IIIe-1, IRRIGATED

Hack loam, 7 to 12 percent slopes, the only soil in this capability unit, is well drained. The annual precipitation is 12 to 18 inches, and the frost free period is 100 to 150 days.

Permeability is moderately slow. Available water capacity is 7 to 11 inches. Typically, roots penetrate to a depth of 40 to more than 60 inches. Runoff is medium, and the hazard of erosion is moderate.

The soil in this capability unit is used for irrigated hay and pasture and for wildlife habitat.

Irrigated alfalfa and alfalfa and grass are grown for hay. Some hay is used for aftermath grazing in the fall, but it should be carefully controlled to protect alfalfa vigor. Alfalfa generally needs annual or semiannual sulfur fertilization, and gypsum is generally used as the source of sulfur. Phosphorus is sometimes needed and should be applied according to recommendations based on soil tests. The first cutting should be done at full bud stage, the second at 1/10 to 1/2 bloom stage, and the third 4 to 6 weeks before the first killing frost. The yield from the third cutting is generally low and is frequently used for aftermath grazing.

Irrigation water is available all summer in most years in areas that have older water rights. Adequate irrigation water is generally available until about July 15 in areas that have newer water rights. Sprinkler irrigation is a better method of irrigation than wild flooding.

Rodents are a serious concern, and control is often necessary to maintain the stand of alfalfa. Perennial weeds are controlled mainly by the use of chemicals.

Irrigated pasture or grain is sometimes grown.

CAPABILITY UNIT IIIe-2, DRYLAND

Hack loam, 7 to 12 percent slopes, the only soil in this capability unit, is well drained. The annual precipitation is 12 to 18 inches, and the frost free period is 100 to 150 days.

Permeability is moderately slow. Available water capacity is 7 to 11 inches. The water supplying capacity is 8 to 12 inches. Typically, roots penetrate to a depth of 40 to more than 60 inches. Runoff is medium, and the hazard of erosion is moderate.

The soil in this capability unit is used for dryland hay and pasture and for wildlife habitat.

Dryland alfalfa or alfalfa and grass are grown for hay and pasture. Alfalfa generally needs sulfur fertilization every 2 or 3 years. Phosphorus is sometimes needed and should be applied according to recommendations based on soil tests.

Rodents are a serious concern, and control is often necessary to maintain the stand of alfalfa. Perennial weeds are controlled mainly by the use of chemicals.

CAPABILITY UNIT IIIw-1, IRRIGATED

Veazie loam, the only soil in this capability unit, is well drained. Slopes are 0 to 3 percent. The annual precipitation is 12 to 18 inches, and the frost free period is 90 to 150 days.

Permeability is moderate. Available water capacity is 3 to 7 inches. Typically, roots penetrate to a depth of 20 to 40 inches. Runoff is slow, and the hazard of erosion is slight. Occasional flooding occurs in winter or early in spring.

The soil in this capability unit is used for irrigated hay, for pasture, and for wildlife habitat.

Irrigated alfalfa and alfalfa and grass are grown for hay. The hay is generally used for aftermath grazing. Grass and grass clover is grown for pasture and hay. Alfalfa and clover generally need annual or semiannual sulfur fertilization. Phosphorus is sometimes needed and should be applied according to recommendations based on soil tests.

Irrigation water is available all summer in most years in areas that have older water rights on the major drainages. Adequate irrigation water is generally available until about the middle of July in areas that have newer water rights from major drainages and from minor drainages. Sprinkler, border, and wild flooding are three of the methods of irrigation.

Perennial weeds are controlled mainly by the use of chemicals.

CAPABILITY UNIT IVe-1, IRRIGATED

Hack gravelly loam, 3 to 15 percent slopes, the only soil in this capability unit, is well drained. The annual precipitation is 12 to 18 inches, and the frost free period is 100 to 150 days.

Permeability is moderately slow. Available water capacity is 7 to 9 inches. Typically, roots penetrate to

a depth of 40 to more than 60 inches. Runoff is medium, and the hazard of erosion is moderate.

The soil in this capability unit is used for irrigated hay and pasture and for wildlife habitat.

Irrigated alfalfa and alfalfa and grass are grown for hay. Some hay is used for aftermath grazing in the fall, but it should be carefully controlled to protect alfalfa vigor. Alfalfa generally needs annual or semiannual sulfur fertilization, and gypsum is generally used as the source of sulfur. Phosphorus is sometimes needed and should be applied according to recommendations based on soil tests. The first cutting should be done at full bud stage, the second at 1/10 to 1/2 bloom stage, and the third 4 to 6 weeks before the first killing frost. The yield from the third cutting is generally low and is frequently used for aftermath grazing.

Irrigation water is available all summer in most years in areas that have older water rights. Adequate irrigation water is generally available until about July 15 in areas that have newer water rights. Sprinkler and wild flooding are two of the methods of irrigation.

Rodents are a serious concern, and control is often necessary to maintain the stand of alfalfa. Perennial weeds are controlled mainly by the use of chemicals.

Irrigated pasture or grain is sometimes grown.

CAPABILITY UNIT IVe–2, DRYLAND

This capability unit consists of well drained Tub and Ukiah soils. Slopes are 2 to 20 percent. The annual precipitation is 11 to 14 inches, and the frost free period is 90 to 120 days.

Permeability is slow. Available water capacity is 3 to 7 inches. The water supplying capacity is 6 to 12 inches. Typically, roots penetrate to a depth of 20 to 40 inches. Runoff is slow to moderate, and the hazard of erosion is slight to moderate.

The soils in this capability unit are used for dryland farming, for range, and for wildlife habitat.

Dryland alfalfa or alfalfa and grass are grown for hay and pasture. Alfalfa generally needs sulfur fertilization every 2 or 3 years. Phosphorus is sometimes needed and should be applied according to recommendations based on soil tests.

Rodents are a serious problem, and control is often necessary to maintain the stand of alfalfa. Perennial weeds are controlled mainly by the use of chemicals.

CAPABILITY UNIT IVw–1, IRRIGATED

This capability unit consists of poorly drained Boyce and Ricco soils. Slopes are 0 to 3 percent. The annual precipitation is 10 to 16 inches, and the frost free period is 100 to 150 days.

Permeability is moderate to slow. Available water capacity is 5 to 13 inches. Typically, roots penetrate to a depth of 24 to 40 inches. Runoff is slow or very slow, and the hazard of erosion is slight. Occasional flooding occurs in winter or early in spring.

The soils in this capability unit are used for irrigated hay and pasture and for wildlife habitat.

Irrigated native grass and grasses and sedges are grown for hay. The hay is generally used for aftermath grazing in the fall. Fertilizer is not generally applied, because fertilizer trials have resulted in little or no increase in yields. Hay should be cut when the grass is in the early bloom stage of growth.

Irrigation water is available all summer in most years in areas that have older water rights. Adequate water is generally available until about July 15 in areas that have newer water rights. Wild flooding is the main method of irrigation.

Irrigated alfalfa and grass and alfalfa hay are grown in a few areas where adequate artificial drainage systems have been installed.

These soils are difficult to reseed because the sod is very heavy.

CAPABILITY UNIT IVs–1, IRRIGATED

Oxbow very stony silty clay loam, 2 to 5 percent slopes, the only soil in this capability unit is well drained. The annual precipitation is 14 to 18 inches, and the frost free period is 90 to 140 days.

Permeability is slow. Available water capacity is 4 to 6 inches. Typically, roots penetrate to a depth of 20 to 40 inches. Runoff is slow, and the hazard of erosion is slight.

The soil in this capability unit is used for range, wildlife habitat, and irrigated pasture and hay.

Irrigated grass and grass and clover are grown for hay. The hay is generally used for aftermath grazing in the fall. Annual nitrogen fertilization is needed on grass. Sulfur is generally needed, and phosphorus is sometimes needed where a grass and clover mixture is grown. Phosphorus should be applied according to recommendations based on soil tests. Hay should be cut when the grass is in the early bloom stage of growth.

Irrigation water is available in most years until about July 15. Wild flooding is the method of irrigation. Reseeding is difficult because of surface stones and the clayey surface layer.

Perennial weeds are controlled mainly by the use of chemicals.

CAPABILITY UNIT IVc–1, DRYLAND

Courtrock loam, 2 to 7 percent slopes, the only soil in this capability unit, is well drained. The annual precipitation is 10 to 13 inches, and the frost free period is 110 to 150 days.

Permeability is moderately rapid. Available water capacity is 6 to 9 inches. The water supplying capacity is 8 to 11 inches. Typically, roots penetrate to a depth of more than 40 inches. Runoff is slow, and the hazard of erosion is slight.

The soil in this capability unit is used for dryland cropland, range, and wildlife habitat.

Dryland alfalfa and alfalfa and grass are grown for hay and pasture. Alfalfa generally needs sulfur fertilization every 2 or 3 years. Phosphorus is sometimes needed and should be applied according to recommendations based on soil tests.

Rodents are a serious concern, and control is often necessary to maintain the stand of alfalfa. Perennial weeds are controlled mainly by the use of chemicals.

Dryland grain hay in a fallow system is sometimes grown.

CAPABILITY UNIT VIe

This capability unit consists of Balder, Fopiano,

Hankins, Helter, Lemonex, McGarr, Ruddley, Simas, Top, and Tub soils. These are well drained soils that formed in loess, volcanic ash, volcanic tuff, old waterlaid sediment, colluvium weathered from basalt, and colluvium and residuum weathered from serpentine. Slopes are 2 to 45 percent. The annual precipitation is 11 to 30 inches, and the frost free period is 20 to 120 days.

Permeability is moderate to slow. Available water capacity is 1 inch to 20 inches. The water supplying capacity is 8 to 20 inches. Typically, roots penetrate to a depth of 10 to 60 inches. Runoff is slow to rapid, and the hazard of erosion is moderate to high.

The soils in this unit are used for range, pasture, timber, and wildlife habitat. For use and management see "Range," "Wildlife," and "Woodland."

CAPABILITY UNIT VIs

This capability unit consists of Daxty, Laycock, Logdell, Oxbow, Oxwall, and Venator soils. These are well drained soils that formed in volcanic tuff, mixed alluvium, colluvium weathered from shale, waterlaid sediment, and colluvium and residuum weathered from shale. Slopes are 2 to 45 percent. The annual precipitation is 12 to 24 inches, and the frost free period is 20 to 150 days.

Permeability is moderate to slow. Available water capacity is 0.5 inch to 11 inches. The water supplying capacity is 4 to 14 inches. Typically, roots penetrate to a depth of 4 to 40 inches or more. Runoff is slow to rapid, and the hazard of erosion is slight to high.

The soils in this capability unit are used for range, pasture, timber, and wildlife habitat. For use and management suggestions see "Range," "Wildlife," and "Woodland."

CAPABILITY UNIT VIIe

This capability unit consists of Helter, McGarr, Top, and Tub soils. These soils are well drained and formed in volcanic ash, loess, residuum weathered from basalt, and waterlaid sediment. Slopes are 35 to 75 percent. The annual precipitation is 11 to 30 inches, and the frost free period is 20 to 120 days.

Permeability is moderately slow to slow. Available water capacity is 3 to 20 inches. Water supplying capacity is 6 to 20 inches. Typically, roots penetrate to a depth of 20 to more than 40 inches. Runoff is rapid, and the hazard of erosion is high.

The soils in this capability unit are used for range, pasture, timber, and wildlife habitat. For use and management suggestions, see "Range," "Wildlife," and "Woodland."

CAPABILITY UNIT VIIs

This capability unit consists of Alding, Anatone, Balder, Daxty, Day, Grell, Gwin, Hack, Laycock, Lemonex, Lickskillet, Logdell, Piersonte, McGarr, Oxwall, Rockly, Ruddley, Simas, Snell, Tub, Ukiah, Venator, Waterbury, and Wrightman soils. These are well drained soils that formed in colluvium weathered from metavolcanic rock, volcanic tuff, waterlaid sediment, colluvium and residuum weathered from serpentine, colluvium and residuum weathered from basalt, colluvium and residuum weathered from shale, and volcanic ash. Slopes are 2 to 75 percent. The annual precipitation is 10 to 24 inches, and the frost free period is 20 to 150 days.

Permeability is moderate to very slow. Available water capacity is 0.5 to 10 inches. Typically, roots penetrate to a depth of 4 to 60 inches. Runoff is slow to rapid, and the hazard of erosion is slight to high.

The soils in this capability unit are used for range, pasture, timber, and wildlife habitat. For use and management suggestions see "Range," "Wildlife," and "Woodland."

CAPABILITY UNIT VIIIe

This capability unit consists only of Badlands. This miscellaneous area is made up of steep to very steep, severely eroded and rapidly eroding areas that are barren and have little or no value for farming, range, woodland, or wildlife habitat. Some larger areas have value as scenic attractions and as a source of fossils. During spring and summer, occasional very heavy rains of short duration cause very heavy sediment loads on major drainageways.

CAPABILITY UNIT VIIIs

This capability unit consists of Dumps. This miscellaneous area is tailings from gold dredging. It consists mainly of rounded and subrounded stones, cobbles, and pebbles in large alternating parallel ridges and troughs. Dumps are used mainly for wildlife habitat. Some areas have been smoothed and used as building sites.

Estimated Yields[3]

Table 2 shows estimated average acre yields of selected crops for the arable soils in the survey area. The data are based on the experience of ranchers and the knowledge of people in the Soil Conservation Service and the Agricultural Extension Service. Estimated yields are based on the most common combination of management practices used by most ranchers in Grant County, Oregon, Central Part.

Yields on irrigated soils are based on adequate, season long irrigation water being available. If adequate water is not available, yields are appreciably below those shown.

The yield data for dryland grass and alfalfa pasture are based on leaving a 50 percent stubble. The estimated yield for dryland wheat is for the year of harvest, which in a summer-fallow system is once in 2 years.

Range[4]

Approximately 70 percent of the survey area is in range. The rugged topography results from geologic faulting and uplifting. This topography is a contributing factor to a wide variety in range sites. Geographically the range is divided into a north and south side by the John Day River, which generally flows east to west through the Area and then north through Picture Gorge. Rolling grassland at the higher, eastern end

[3] WILLIAM K. FARRELL, Grant County Agricultural Extension Agent, helped prepare this subsection.

[4] A. V. BAHN, soil conservationist, Soil Conservation Service, assisted in preparation of this subsection.

TABLE 2.—*Yields per acre of crops and pasture*

[Yields in columns N are for nonirrigated soils; those in columns I are for irrigated soils. All yields were estimated for a high level of management in 1975. Absence of a yield figure indicates the crop is seldom grown or is not suited]

Soil name and map symbol	Alfalfa hay		Grass hay		Hay crops, annuals		Pasture		Wheat, winter	
	N	I	N	I	N	I	N	I	N	I
	Ton	*Ton*	*Ton*	*Ton*	*Ton*	*Ton*	*AUM* [1]	*AUM* [1]	*Bu*	*Bu*
Boyce:										
5				2.5				6		
Courtrock:										
6B		6.0						14	20	80
Dayville:										
9		6.5		3.5						
Hack:										
16A, 16B, 16C		6.5						13		
17C		6.0						13		
Oxbow:										
30B				3.0						
Powder:										
34		6.5						14		
Ricco:										
35						2.5				
Ukiah:										
50B					1.5				30	
Veazie:										
53		5.0						15		

[1] Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for a period of 30 days.

of the valley gives way to a narrower valley that has steeper grassland oriented toward the west. Valuable spring and fall livestock range and winter game range are provided by these areas. Summer range is provided by bordering timbered mountains and meadows.

Studies of relic areas and excellent condition range indicate that the original grassland was dominated by extensive stands of bluebunch wheatgrass on south facing slopes and Idaho fescue on north facing slopes. Tufted hairgrass, redtop, and sedges grew on wet meadows. Giant wildrye dominated the drier bottom land and occurred sporadically on uplands. A variety of forbs formed an integral part of the original or climax plant communities. Shrubs are characteristic of the survey area and dominate the aspect of many sites. Bitterbrush, a valuable browse species, is prominent (fig. 6). Its growth habit makes it well suited to areas of shale and fractured rock where it can obtain water from its deep root system. Mountainmahogany occurs on areas of stony shallow soils, particularly those bordering pine trees. Juniper is mainly on stony south slopes, on ridges, and in dry canyons.

Since the advent of livestock grazing, marked changes have occurred in a large part of the Area. (*3*). The more desirable grasses such as Idaho fescue and bluebunch wheatgrass have decreased, particularly on spring and fall range and in big game wintering areas. Bitterbrush has decreased and unpalatable shrubs have strongly increased. Big sagebrush, low sagebrush, rabbitbrush, and matchweed dominate many sites. Erosion has become a concern where annuals and forbs provide a poor ground cover. The widespread invasion of western juniper is also notable, particularly on south slopes.

These changes are not complete since plant communities are dynamic. Close observation of range sites determines the ecological condition and trend of any given area.

Range sites and condition classes

A range site is a distinctive kind of rangeland that differs from other rangeland in its potential to produce native plants. It is the product of all environmental factors responsible for its development. Sites are differentiated on the basis of the potential or climax plant community. Criteria are differences in the kinds of original plants, proportion of original plants, or total annual production.

Range condition is the present state of vegetation on a range site in relation to the climax or potential plant community for that site. It serves as a standard for judging the changes that have taken place and provides a basis for predicting future responses. The four condition classes used are *excellent, good, fair,*

Figure 6.—Bitterbrush growing on an area of Anatone-Wrightman complex, 3 to 25 percent slopes.

and *poor*. A range is in excellent condition if 75 percent or more of the vegetation is the same kind as that on the original stand and if there is no current erosion; it is in good condition if the percentage is between 50 and 75 percent, and erosion is no more than slight; it is in fair condition if the percentage is between 25 and 50 percent, and erosion is no more than moderate; and it is in poor condition if the percentage is less than 25 percent or erosion is severe.

Descriptions of the range sites

There are 14 range sites in the survey area. Each is described as it occurs in near-climax condition and according to the changes that take place as the site deteriorates or improves from a deteriorated condition. The original plant composition for each site, the total annual production, and the available production for cattle are given as estimates. Mapping units for each soil can be found at the back of the survey in the "Guide to Mapping Units."

ROLLING HILLS RANGE SITE

This range site consists of Balder and Tub soils. The soils are well drained stony loams and stony clay loams that formed in fine textured old calcareous sediment and colluvium weathered from volcanic tuff bedrock on uplands. Slopes are 3 to 20 percent. Elevation ranges from 2,100 to 4,200 feet. The average annual precipitation is 11 to 18 inches.

Runoff is slow to medium, and the hazard of erosion is slight or moderate. Permeability is slow to moderate, available water capacity is 1 inch to 7 inches, and water supplying capacity is 6 to 9 inches. Roots penetrate to a depth of 10 to 40 inches.

The potential plant community of this site is dominated by bluebunch wheatgrass. Idaho fescue and Sandberg bluegrass are prominent. A wide variety of perennial forbs such as biscuitroot, milkvetch, buckwheat, fleabane, lupine, phlox, pussytoes, and yarrow are present. Bitterbrush and minor amounts of other shrubs are also present.

The estimated composition of the potential community by percentage of total weight is bluebunch wheatgrass, 60 percent; Idaho fescue, 15 percent; Sandberg bluegrass, 10 percent; perennial forbs, 10 percent; and shrubs, 5 percent.

As the condition of the site deteriorates because of heavy cattle use, bluebunch wheatgrass and Idaho fescue lose vigor and decrease in the stand. They are replaced by Sandberg bluegrass and perennial forbs

which can in turn be reduced by sheep and deer use. As deterioration increases, annual grasses and forbs increase along with shrubs such as matchweed, big sagebrush, and gray rabbitbrush. Juniper invade the site at times (fig. 7).

As the condition of the site improves, clumps of existing bluebunch wheatgrass show increased vigor as evidenced by larger crowns and more and longer leaves and seedstalks; palatable forbs increase and twig growth on forage shrubs becomes normal; residue accumulates around clumps of grass and under shrubs; and perennial grass seedlings and Sandberg bluegrass become established in barren spots.

Areas of suitable soils in low, fair, or poor condition can be reseeded. Brush and juniper management is practical in areas where a reasonably good stand of perennial grasses occurs and in areas where seeding is possible. Plans for controlling shrubs and weeds should consider the amount and value of the existing forage shrubs.

Bluebunch wheatgrass is the major forage producing plant. In excellent condition, total annual production is estimated at 1,000 pounds per acre in years of favorable moisture and 400 pounds in dry years. Usable production for cattle is about 900 pounds and 350 pounds. The usable production in pounds per acre is the amount of herbage available to and readily grazed by cattle but is not to be construed as proper grazing use for the site. Growth of the major forage grasses begins about March 15 and ends about July 15.

MOIST ROLLING HILLS RANGE SITE

This range site consists of Ukiah stony silty clay loam, 2 to 8 percent slopes, and Ukiah very stony silty clay loam, 3 to 15 percent slopes. These well drained soils formed in colluvium weathered from volcanic tuff on uplands. Slopes are 2 to 15 percent. Elevation is 3,000 to 4,600 feet. The average annual precipitation is 15 to 20 inches.

Runoff is medium, and the hazard of erosion is moderate. Permeability is very slow, available water capacity is 2.5 to 6 inches, and the water supplying capacity is 6 to 12 inches. The effective rooting depth is 20 to 40 inches.

The potential plant community of this site is strongly dominated by Idaho fescue. Bluebunch wheatgrass and Sandberg bluegrass are prominent. A wide variety of perennial forbs such as lupine, milkvetch, cinquefoil, geranium, hawkweed, avens, and paint-

Figure 7.—**Juniper trees invading an area of Tub stony clay loam, 3 to 20 percent slopes; Rolling Hills range site.**

brush are present. A few shrubs, rose, snowberry, and Oregon-grape are present in places.

The estimated composition of the potential community by percentage of total weight is Idaho fescue, 70 percent; bluebunch wheatgrass, 15 percent; Sandberg bluegrass, 5 percent; and perennial forbs, 10 percent.

As the condition of the site deteriorates because of excessive cattle and elk use, Idaho fescue loses vigor and decreases in the stand. It is replaced by bluebunch wheatgrass, Sandberg bluegrass, and perennial forbs. As deterioration increases, the site becomes weedy and annuals and low value forbs increase.

As the condition of the site recovers, Idaho fescue improves in vigor, residue accumulates around clumps of grass, bunchgrass seedlings become established, and the stand of grass thickens.

Areas of suitable soils in poor condition can be seeded to suited forage plants. Spraying is practical if a reasonably good stand of forage plants is under brush. Use of the site by game should be taken into account, however, in any improvement program.

Idaho fescue is the major forage producing plant. In excellent condition, total annual production is estimated at 1,500 pounds per acre in years of favorable moisture and 700 pounds in dry years. Usable production for cattle is about 1,400 pounds and 650 pounds. Growth of the major forage grasses begins about April 5 and ends about July 15.

SCABLAND RANGE SITE

This range site consists of Rockly and Anatone soils. These soils are well drained extremely stony loams. The soils formed on uplands in a mixture of rock fragments, colluvium, and residuum weathered from basalt, loess, and volcanic ash. Slopes are 2 to 70 percent. Elevation is 3,000 to 5,500 feet. The average annual precipitation is 14 to 28 inches.

Runoff is slow to medium, and the hazard of erosion is moderate or high. Permeability is moderate, available water capacity is ½ inch to 1.8 inches, and the water supplying capacity is 1 inch to 5 inches. The effective rooting depth is 5 to 20 inches.

The potential plant community of this site is dominated by low sagebrush. Bluebunch wheatgrass and minor amounts of Idaho fescue, other bunchgrasses, and onespike danthonia are common. A variety of perennial forbs such as biscuitroot, scab balsamroot, phlox, onion, yarrow, bighead clover, and buckwheat are present.

The estimated composition of the potential community by percentage of total weight is low sagebrush, 65 percent; Sandberg bluegrass, 15 percent; bluebunch wheatgrass, 10 percent; Idaho fescue, 5 percent; and forbs, 5 percent.

When grazed by cattle or elk, this site seldom deteriorates below good condition because of the low foliage of Sandberg bluegrass and its short green season. Grazing by deer and sheep late in fall and in winter and spring can cause deterioration. Severe use during these seasons nearly eliminates Sandberg bluegrass and leaves only bare ground, stones, and hedged sagebrush.

As the condition of the site improves, seedlings of Sandberg bluegrass become established in barren spots, bluebunch wheatgrass and Idaho fescue show increased vigor, and residue accumulates around grass clumps.

Brush should not be sprayed on this site. Low sagebrush is a natural component of the plant community. It provides valuable forage, particularly for game, from late in fall to early in spring.

Sandberg bluegrass is the major forage plant on this site. In excellent condition, total annual production is estimated at 400 pounds per acre in years of favorable moisture and 300 pounds in dry years. For a short period of time in spring and fall, usable production for cattle is about 100 pounds and 50 pounds. Growth of the major forage grasses begins about April 5 and ends about June 15.

DEEP SCABLAND RANGE SITE

This range site consists of Waterbury extremely stony silty clay loam, 3 to 40 percent slopes. This soil formed in colluvium weathered mainly from tuff and basalt. It is generally on south facing slopes on uplands. Elevation is 3,000 to 4,600 feet. The average annual precipitation is 13 to 18 inches.

Runoff is medium to rapid, and the hazard of erosion is moderate or high. Permeability is very slow, available water capacity is 1 inch to 2.5 inches, and the water supplying capacity is 6 to 9 inches. Roots penetrate to a depth of 12 to 20 inches.

The potential plant community of this site is dominantly low sagebrush. Bluebunch wheatgrass and Idaho fescue are prominent in the stand. A variety of perennial forbs such as bighead clover, serrate balsamroot, buckwheat, biscuitroot, and pearlyeverlasting are present.

The composition of the potential community by percentage of total weight is low sagebrush, 45 percent; Sandberg bluegrass, 15 percent; bluebunch wheatgrass, 15 percent; Idaho fescue, 15 percent; and perennial forbs, 10 percent.

As the condition of the site deteriorates because of excessive use, bluebunch wheatgrass and Idaho fescue decrease. They are replaced by Sandberg bluegrass and annuals. Sandberg bluegrass seldom decreases under these conditions because of its low foliage and short green season. Heavy use by sheep and deer late in fall and in winter and spring, however, cause deterioration of the Sandberg bluegrass sod. Severe use causes annuals and low value forbs to increase rapidly. Juniper and shrubs invade some areas.

As the condition of the site improves, clumps of existing bluebunch wheatgrass and Idaho fescue show increased vigor, seedlings of Sandberg bluegrass become established, residue accumulates around clumps of grass, and grass seedlings become established.

This site generally is not suited to special improvement practices. The stony soil precludes seeding under present available methods. Brush management is generally not an alternative as shrubs are generally scarce.

Bluebunch wheatgrass and Idaho fescue are the major forage producing plants. Sandberg bluegrass furnishes quality forage for only a short period of time in spring and fall. In excellent condition, total annual production is estimated at 600 pounds per acre in years of favorable moisture and 400 pounds in dry

years. Usable production for cattle is about 300 pounds and 200 pounds. Growth of the major forage grasses begins about April 5 and ends about June 15.

SHRUBBY ROLLING HILLS RANGE SITE

This range site consists of Wrightman soil. This soil formed in colluvium and alluvium from basaltic rock and loess. It occurs as circular mounds that have a convex surface. The mounds are 15 to 40 feet in diameter and about 35 feet apart. Elevation is 4,000 to 5,200 feet. The average annual precipitation is 16 to 25 inches.

Runoff is medium, and the hazard of erosion is moderate. Permeability is moderate, available water capacity is 3 to 7 inches, and the water supplying capacity is 13 to 16 inches. Roots penetrate to a depth of 20 to 40 inches.

The potential plant community of this site is strongly dominated by Idaho fescue, bluebunch wheatgrass, Sandberg bluegrass, and junegrass are prominent. Giant wildrye and a variety of perennial forbs such as buckwheat, lupine, cinquefoil, fleabane, milkvetch, paintbrush, and yarrow are present. Bitterbrush dominates the aspect of the site. A variety of other shrubs in minor amounts are also present.

The estimated composition of the potential community by percentage of total weight is Idaho fescue, 55 percent; bluebunch wheatgrass, 15 percent; prairie junegrass, 5 percent; perennial forbs, 5 percent; bitterbrush and other shrubs, 20 percent.

As the condition of the site deteriorates because of excessive use, Idaho fescue loses vigor and decreases in the stand. It is replaced by bluebunch wheatgrass, Sandberg bluegrass, and forbs. If deterioration increases, Sandberg bluegrass, low value forbs, annuals, and unpalatable shrubs strongly increase. Excessive use by sheep and deer severely reduces Sandberg bluegrass and causes the forage shrubs to become severely hedged.

As the condition of the site improves, the forage grasses improve in vigor; residue accumulates around clumps of grass and under shrubs; bunchgrass seedlings become established; palatable forbs increase; and twig growth on forage shrubs becomes normal.

Areas in poor condition are well suited to seeding to suited forage plants. Brush management is practical if the stand of forage plants is reasonably good, but the amount and value of existing bitterbrush and other forage shrubs for game use in winter and spring should be considered.

Idaho fescue is the major forage producing plant. In excellent condition, total annual production is estimated at 1,300 pounds per acre in years of favorable moisture and 800 pounds in dry years. Usable production for cattle is 1,000 pounds and 500 pounds. Growth of the major forage producing plants begins about April 1 and ends about July 15.

DROUGHTY TERRACE RANGE SITE

This range site consists of Oxbow and Oxwall soils. These soils are well drained very stony or extremely stony silty clay loams. These soils formed on old terraces in waterlaid sediment. Slopes are 2 to 7 percent. Elevation is 2,700 to 4,200 feet. The average annual precipitation is 14 to 18 inches.

Runoff is slow, and the hazard of erosion is slight. Permeability is slow, available water capacity is 1.3 to 6 inches, and the water supplying capacity is 7 to 12 inches. Roots penetrate to a depth of 10 to 40 inches.

The potential plant community of this site is dominantly bluebunch wheatgrass. Sandberg bluegrass and Idaho fescue are prominent in the stand. A variety of perennial forbs such as biscuitroot, lupine, phlox, pussytoes, buckwheat, yarrow, milkvetch, and onion are present. Minor amounts of bitterbrush and other shrubs are also present.

The estimated composition of the potential community by percentage of total weight is bluebunch wheatgrass, 60 percent; Sandberg bluegrass, 10 percent; Idaho fescue, 25 percent; and perennial forbs, 5 percent.

As the condition of the site deteriorates because of excessive use, bluebunch wheatgrass and Idaho fescue lose vigor and decrease in the stand. They are replaced by Sandberg bluegrass, which increases strongly, squirreltail, biscuitroot, and other perennial forbs. If deterioration is severe, Sandberg bluegrass decreases, annuals increase, trampling damage is evident, and areas of bare ground and stone are prominent. Very few shrubs are present.

As the condition of the site improves, existing forage bunchgrasses show signs of increased vigor; seedlings of Sandberg bluegrass become established in barren spots; residue accumulates on the surface; and areas of bare ground decrease.

Less stony areas in low, fair, and poor condition can be seeded to suited forage plants. Rocky areas are not well suited to seeding by present available methods.

Bluebunch wheatgrass is the major forage producing plant. In excellent condition, total annual production is estimated at 700 pounds per acre in years of favorable moisture and 450 pounds in dry years. Usable production for cattle is 600 pounds and 400 pounds. Growth of the major forage producing plants begins about March 1 and ends June 15.

CLAYEY TERRACE RANGE SITE

This range site consists of Fopiano silty clay loam, 2 to 15 percent slopes. This well drained soil formed in colluvium and residuum from old sediment and tuff on uplands. It is on undulating uplands. Elevation is 3,800 to 5,000 feet. The average annual precipitation is 13 to 16 inches.

Runoff is medium, and the hazard of erosion is moderate. Permeability is slow, available water capacity is 2 to 3 inches, and the water supplying capacity is 8 to 10 inches. Roots penetrate to a depth of 10 to 20 inches.

The potential plant community of this site is dominantly Idaho fescue. Bluebunch wheatgrass and Sandberg bluegrass are prominent. A variety of forbs such as phlox, fleabane, buckwheat, biscuitroot, lupine, pussytoes, and yarrow are present. Low sagebrush dominates the aspect of the site, and several other shrub species are present in minor amounts.

The estimated composition of the potential community by percentage of total weight is Idaho fescue, 60 percent; bluebunch wheatgrass, 10 percent; Sandberg bluegrass, 5 percent; perennial forbs, 5 percent; and low sagebrush, 20 percent.

As the condition of the site deteriorates because of excessive use, Idaho fescue and bluebunch wheatgrass lose vigor and decrease in the stand. They are replaced by Sandberg bluegrass, annual grasses, low value forbs, and sagebrush. Heavy sheep and deer use causes Sandberg bluegrass to decrease and low sagebrush to become hedged. If deterioration is severe, barren spots occur and sagebrush, annuals, and low value forbs dominate.

As the condition of the site improves, clumps of existing Idaho fescue and bluebunch wheatgrass show increased vigor as evidenced by more and longer leaves and seedstalks; residue accumulates around clumps of grass and under shrubs; bunchgrass seedlings increase under the protection of litter; perennial forbs increase; and twig growth on low sagebrush becomes normal.

Areas of suitable soils in low, fair, and poor condition can be reseeded. If low sagebrush is prominent, it provides valuable wildlife forage. Brush management should maintain low sagebrush.

Idaho fescue and bluebunch wheatgrass are the major forage producing plants. In excellent condition, total annual production is estimated at 1,200 pounds per acre in years of favorable moisture and 600 pounds in dry years. Usable production for cattle is about 1,000 pounds and 450 pounds. Growth of the major forage species begins about April 1 and ends about July 15.

DROUGHTY SOUTH EXPOSURE RANGE SITE

This range site consists of Simas, Day, and Lickskillet soils. These soils are well drained clays, clay loams, very stony or extremely stony clay loams, or loams. These soils formed in loess, in colluvium, and in clayey sediment. They are on uplands and generally have south facing slopes. Slopes are 5 to 70 percent. Elevation is 2,100 to 4,000 feet. The average annual precipitation is 10 to 14 inches.

Runoff is medium to rapid, and the hazard of erosion is moderate or high. Permeability is moderate to very slow, available water capacity is 1 inch to 10 inches, and the water supplying capacity is 2 to 12 inches. Roots penetrate to a depth of 12 to 60 inches.

The potential plant community of this site is dominantly bluebunch wheatgrass. Sandberg bluegrass and minor amounts of Thurber needlegrass and squirreltail are prominent. A variety of perennial forbs such as buckwheat, fleabane, lupine, milkvetch, phacelia, phlox, and yarrow are present. A small amount of snakeweed, bitterbrush, gray rabbitbrush, and big sagebrush are also present.

The estimated composition of the potential plant community by percentage of total weight is bluebunch wheatgrass, 75 percent; Sandberg bluegrass, 10 percent; perennial forbs, 10 percent; and shrubs, 5 percent.

As the condition of the site deteriorates because of excessive use, bluebunch wheatgrass loses vigor and decreases. It is replaced by perennial forbs and Sandberg bluegrass. These plants in turn can be reduced because of use by sheep and deer. If deterioration is severe, annuals, low value forbs, snakeweed, big sagebrush, and rabbitbrush become prominent. Bare ground is very evident. Juniper invades readily in the absence of fire. Without protective plant cover, the soils of this site are very susceptible to water erosion (fig. 8). Stones exposed by erosion and frost heaving form a pavement which seriously hinders the establishment of desirable plants, reduces potential recovery, and increases water loss through runoff.

When this site begins to recover from a depleted condition, the clumps of existing bunchgrass show increased vigor evidenced by more and longer leaves and seed stalks, residue accumulates around clumps of grass, grass seedlings become established, and Sandberg bluegrass becomes established in barren spots.

Areas of suitable soils in low, fair, and poor condition can be seeded to suited forage plants. Juniper removal, where needed, followed by seeding of disturbed areas is practical. Spraying is also practical if a reasonably good stand of perennial grasses is under the brush or if seeding without seedbed preparation is planned. Improvement plans should take into account the amount and value of existing forage shrubs as this site provides winter and early spring forage for deer.

Bluebunch wheatgrass is the major forage producing plant on this site. In excellent condition, total annual production is estimated at 600 pounds per acre in years of favorable moisture and 250 pounds in dry years. Usable production for cattle is about 550 pounds and 200 pounds. Growth of the major forage species begins about March 1 and ends about June 1.

SOUTH EXPOSURE RANGE SITE

This range site consists of Balder, Grell, Gwin, and Ukiah soils. These soils are well drained very stony loams, very stony or extremely stony silt loams, very gravelly loams, and extremely stony silty clay loams. They formed in colluvium and residuum from volcanic

Figure 8.—**Erosion following a cloudburst on area of Simas very stony clay loam, 8 to 40 percent south slopes.**

tuff, serpentine bedrock, and basalt mixed with loess and volcanic ash. They are on uplands and generally have south facing slopes of 3 to 70 percent. Elevation is 3,000 to 5,000 feet. The average annual precipitation is 13 to 20 inches.

Runoff is medium to rapid, and the hazard of erosion is moderate or high. Permeability is moderate to very slow, the available water capacity is about 1 inch to 6 inches, and the water supplying capacity is about 1 inch to 14 inches. Roots penetrate to a depth of 10 to 40 inches.

The potential plant community of this site is dominantly bluebunch wheatgrass. Idaho fescue and Sandberg bluegrass are prominent in the stand. A wide variety of perennial forbs such as yarrow, phlox, milkvetch, fleabane, arrowleaf balsamroot, biscuitroot, and buckwheat are present. Bitterbrush is present, and minor amounts of other shrubs are also present.

The estimated composition of the potential community by percentage of total weight is bluebunch wheatgrass, 65 percent; Idaho fescue, 5 percent; Sandberg bluegrass, 10 percent; perennial forbs, 10 percent; and shrubs, 10 percent.

As the condition of the site deteriorates because of excessive use, bluebunch wheatgrass and Idaho fescue lose vigor and decrease in the stand. They are replaced by Sandberg bluegrass and forbs. These plants in turn can be reduced because of use by sheep and deer. If deterioration is severe, matchweed, sagebrush, rabbitbrush, low value forbs, and annuals become prominent. Forage shrubs become closely hedged. Juniper invades rapidly in the absence of fires. Without protective plant cover, the soils of this site are very susceptible to water erosion. Stones exposed by erosion and frost heaving form a pavement which seriously hinders the establishment of desirable plants, reduces potential recovery, and increases water loss through runoff.

As this site begins to recover from a depleted condition, the clumps of existing blunchgrass show signs of increased vigor evidenced by more and longer leaves and seed stalks, residue accumulates around clumps of grass, grass seedlings become established, and Sandberg bluegrass becomes established in barren spots.

Areas of suitable soils in low, fair, and poor condition can be seeded to suited forage plants. Juniper removal, where needed, followed by seeding disturbed areas is practical. Brush management is practical if the stand of perennial grasses is reasonably good or seeding is possible. Because this site provides valuable forage for elk and deer late in fall, in winter, and in spring, game use and requirements should be taken into account.

Bluebunch wheatgrass is the major forage producing plant. In excellent condition, total annual production is estimated at 900 pounds per acre in years of favorable moisture and 350 pounds in dry years. Usable production for cattle is about 850 pounds and 300 pounds. Growth of the major forage grasses begins about March 15 and ends about July 1.

SHRUBBY SOUTH EXPOSURE RANGE SITE

This range site consists of Venator very shaly loam soils. These soils are well drained and are on uplands, generally on south facing slopes. They formed in residuum and colluvium from shale. Slopes are 5 to 65 percent. Elevation is 4,000 to 5,000 feet. The average annual precipitation is 13 to 16 inches, and the average annual air temperature is 46° to 48° F.

Runoff is medium or rapid, and the hazard of erosion is moderate or high. Permeability is moderate, available water capacity is about 1 inch to 2.5 inches, and the water supplying capacity is about 4 to 7 inches. Roots penetrate to a depth of 10 to 20 inches.

The potential plant community on this site is dominantly bluebunch wheatgrass. Sandberg bluegrass, Idaho fescue, and Thurber needlegrass are prominent in the stand. A wide variety of perennial forbs such as milkvetch, phlox, buckwheat, fleabane, arrowleaf balsamroot, biscuit root, lupine, and agoseris are present. Bitterbrush and a minor amount of other shrubs are prominent, and the site has a shrubby appearance.

The estimated composition of the potential plant community by percentage of total weight is bluebunch wheatgrass, 35 percent; Thurber needlegrass, 5 percent; Sandberg bluegrass, 5 percent; Idaho fescue, 5 percent; perennial forbs, 10 percent; bitterbrush and other shrubs, 40 percent.

As the condition of the site deteriorates because of excessive use, bluebunch wheatgrass and Idaho fescue lose vigor and decrease in the stand. They are replaced by Sandberg bluegrass and forbs. Heavy use by deer and sheep hedges and reduces the vigor of bitterbrush and other forage shrubs. Juniper readily invades the site in the absence of fire. Severe use causes annuals, forbs, and low value shrubs to invade and increase rapidly. Without protective plant cover, soils of this site are very susceptible to water erosion. Stones exposed by erosion and frost heaving form a pavement which seriously hinders the establishment of desirable plants, reduces potential recovery, and increases water loss through runoff.

As the condition of the site improves, clumps of existing bunchgrasses show increased vigor, forage shrubs produce longer twig growth, residue accumulates around clumps of grass, and grass seedlings become established.

Areas of soils in low, fair, and poor condition can be improved by seeding to suited forage plants. Juniper removal, where needed, followed by seeding the disturbed area is practical. Because the forage shrubs on this site provide valuable winter and spring feed for game, brush management plans should consider the amount and value of existing shrubs.

Bluebunch wheatgrass is the major forage producing plant. In excellent condition, total annual production is estimated at 900 pounds per acre in years of favorable moisture and 500 pounds in dry years. Usable production is about 500 pounds and 350 pounds. Growth of the major forage grasses begins about March 15 and ends about July 1.

DROUGHTY NORTH EXPOSURE RANGE SITE

This range site consists of Grell very gravelly loam, 15 to 40 percent north slopes. This well drained soil formed in colluvium and residuum from serpentine bedrock on uplands. Elevation is 3,000 to 5,000 feet. The average annual precipitation is 13 to 18 inches, and the average annual air temperature is 45° to 50° F.

Runoff is medium or rapid, and the hazard of erosion is moderate or high. Permeability is moderate, available water capacity is ½ inch to 2.5 inches, and the water supplying capacity is 6 to 8 inches. Roots penetrate to a depth of 10 to 20 inches.

The potential plant community of this site is dominantly bluebunch wheatgrass. Idaho fescue is prominent. Sandberg bluegrass and a wide variety of perennial forbs such as fleabane, yarrow, milkvetch, biscuitroot, buckwheat, woolyweed, and lupine are present. Bitterbrush and a variety of other shrubs are also present in minor amounts.

The estimated composition of the potential community by percentage of total weight is bluebunch wheatgrass, 50 percent; Idaho fescue, 35 percent; Sandberg bluegrass, 5 percent; perennial forbs, 5 percent; and shrubs, 5 percent.

As the condition of the site deteriorates because of excessive use, bluebunch wheatgrass and Idaho fescue lose vigor and decrease in the stand. They are replaced by Sandberg bluegrass, perennial forbs, and annuals. If deterioration increases, annuals and unpalatable shrubs such as big sagebrush, rabbitbrush, and matchweed increase. Juniper invades rapidly in the absence of fire.

As the condition of the site improves, bluebunch wheatgrass and Idaho fescue show increased vigor evidenced by more and longer leaves and seedstalks, twig growth on forage shrubs becomes normal, residue accumulates around clumps of grass shrubs, and perennial grass seedlings become established.

Areas of suitable soils in low, fair, and poor condition can be improved by seeding. Brush and juniper management is practical in areas where a reasonably good stand of grass occurs and in areas in poor condition if seeding is possible. Because this site provides valuable feed for deer and elk, plans for shrub management should consider the amount and value of existing forage shrubs.

Bluebunch wheatgrass and Idaho fescue are the major forage producing plants. In excellent condition, total annual production is estimated at 650 pounds per acre in years of favorable moisture and 300 pounds in dry years. Usable production for cattle is about 600 pounds and 250 pounds. Growth of the major forage grasses begins about March 20 and ends about June 20.

NORTH EXPOSURE RANGE SITE

This range site consists of Snell, Tub, and Fopiano soils. These well drained soils have a surface layer that ranges from silty clay loam and clay loam to very stony and extremely stony loam. Slopes are 15 to 70 percent and generally are north facing. The Snell soils formed in loess, basaltic colluvium, and residuum from basalt bedrock on uplands. The Tub soils formed in fine textured old calcareous sediment, and the Fopiano soils formed in colluvium and residuum from old sediment and tuff on uplands. Elevation is 2,100 to 5,000 feet. The average annual precipitation is 11 to 20 inches, and the average annual air temperature is 42° to 48° F.

Runoff is medium or rapid, and the hazard of erosion is moderate or high. Permeability is moderately slow or slow, available water capacity is 2 to 7 inches, and the water supplying capacity is 6 to 14 inches. Roots penetrate to a depth of 10 to 40 inches.

The potential plant community of this site is strongly dominated by Idaho fescue. Bluebunch wheatgrass and Sandberg bluegrass are prominent. A wide variety of perennial forbs such as buckwheat, fleabane, milkvetch, lupine, phlox, hawksbeard, lomatium, paintbrush, pussytoes, and yarrow are present. Bitterbrush and a minor amount of other shrubs are also present.

The estimated composition of the potential plant community by percentage of total weight is Idaho fescue, 65 percent; bluebunch wheatgrass, 15 percent; Sandberg bluegrass, 5 percent; perennial forbs, 5 percent; and shrubs, 10 percent.

As the condition of the site deteriorates because of excessive cattle use, Idaho fescue loses vigor, decreases, and is replaced by Sandberg bluegrass and bluebunch wheatgrass. If deterioration continues, bluebunch wheatgrass decreases and annual grasses, low value forbs, and shrubs strongly invade. Juniper also invades in the absence of fire.

As the condition of the site improves, Idaho fescue and bluebunch wheatgrass show increased vigor evidenced by more and longer leaves and seedstalks, residue accumulates around clumps of grass and shrubs, bunchgrass seedlings become established, palatable forbs increase, and twig growth on forage shrubs becomes normal.

Areas of suitable soils in poor condition can be reseeded. Brush and juniper management is practical in areas where a reasonably good stand of grass occurs and in areas in poor condition if seeding is possible. Because the site provides spring and fall forage for deer and elk, normal use by game needs to be considered in considering any improvement program.

Idaho fescue and bluebunch wheatgrass are the major forage producing plants. In excellent condition, total annual production is estimated at 1,300 pounds per acre in years of favorable moisture and 750 pounds per acre in dry years. Usable production for cattle is about 1,200 pounds and 700 pounds. Growth of the major forage grasses begins about March 25 and ends about July 25.

MAHOGANY ROCKLAND RANGE SITE

This range site consists of Logdell soils and Lithic Xerochrepts mapped in complexes with Daxty, Lemonex, Ruddley, and Alding soils and Rock outcrop. The soils are well drained very shaly loams or very stony or very cobbly clays or clay loams. Slopes are 15 to 75 percent. The Logdell soils formed on uplands in shaly colluvium and residuum weathered from finely fractured shale interbedded in places with sandstone and graywacke. Elevation is 3,000 to 5,500 feet. The average annual precipitation is 17 to 28 inches, and the average annual air temperature is 40° to 45° F.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. Permeability is moderate, available water capacity is ½ inch to 2 inches, and the water supplying capacity is 3 to 10 inches. The effective rooting depth is 4 to 15 inches.

The potential plant community of this site is dominantly stands of curlleaf mountainmahogany. The understory is dominantly Idaho fescue. Bluebunch

wheatgrass, Sandberg bluegrass, and Canby bluegrass are prominent. A variety of perennial forbs such as arrowleaf balsamroot, biscuitroot, buckwheat, lupine, blue-eyegrass, pussytoes, fleabane, phlox, yarrow, and onion are present. Bitterbrush and minor amounts of other shrubs are also present.

The estimated composition of the potential community by percentage of total weight is curlleaf mountainmahogany, 60 percent; Idaho fescue, 10 percent; bluebunch wheatgrass, 5 percent; Sandberg bluegrass, 5 percent; Canby bluegrass, 5 percent; perennial forbs, 5 percent; bitterbrush and other shrubs, 10 percent.

As the condition of the site deteriorates because of excessive use, Idaho fescue decreases and is replaced by Sandberg bluegrass, bluebunch wheatgrass, perennial forbs, and big sagebrush. Severe deterioration of the understory because of concentrations of deer in the winter and early spring or cattle in the summer, or both, results in an increase in mahogany, annuals, low value forbs, and juniper. Without protective plant cover, the soils of this site are very susceptible to erosion by water. Shale and stones form a pavement that seriously hinders the reestablishment of desirable plants, reduces potential recovery, and increases water loss through runoff.

As the condition of the site improves, clumps of existing bunchgrass show signs of increased vigor; perennial forbs, bunchgrass, and Sandberg bluegrass increase; residue accumulates; and grass seedlings become established.

This site is suited to only limited improvement. It is commonly an important natural winter and spring range for big game—a factor that needs to be considered in any improvement program.

Idaho fescue and bluebunch wheatgrass are the major forage producing plants. In excellent condition, total annual production is estimated at 2,000 pounds per acre in years of favorable moisture and 1,500 pounds in dry years. Usable production for cattle is about 500 pounds and 200 pounds. Growth of the major forage grasses begins about March 5 and ends about June 15.

BOTTOM LAND FAN RANGE SITE

This range site consists of Hack soils. These soils have a surface layer of loam, gravelly loam, or extremely stony loam. They formed in mixed alluvium on alluvial fans, terraces, and foot slopes. Slopes are 0 to 20 percent. Elevation is 1,800 to 3,800 feet. The average annual precipitation is 12 to 18 inches, and the average annual air temperature is 45° to 51° F.

Runoff is slow to medium, and the hazard of erosion is slight to moderate. Permeability is moderately slow, available water capacity is 7 to 11 inches, and the water supplying capacity is 8 to 12 inches. Roots penetrate to a depth of more than 40 inches.

The potential plant community of this site is dominantly giant wildrye. Idaho fescue and bluebunch wheatgrass are prominent. Sandberg bluegrass, prairie junegrass, big bluegrass, Columbia needlegrass, and a variety of other grasses and dryland sedges are present. Perennial forbs such as yarrow, buckwheat, lupine, redbar avens, fleabane, pearlyeverlasting, and phlox are present. Minor amounts of shrubs such as bitterbrush, sagebrush, snowberry, rose, and green rabbitbrush also are present.

The estimated composition of the potential plant community by percentage of total weight is giant wildrye, 70 percent; Idaho fescue, 15 percent; bluebunch wheatgrass, 5 percent; perennial forbs, 5 percent; and shrubs, 5 percent.

As the condition of the site deteriorates, the understory bunchgrasses lose vigor and decrease. They are replaced by sod formers. If deterioration continues, the vigor and stand of giant wildrye decreases. Less desirable forbs and annuals become prominent. Big sagebrush and rabbitbrush strongly invade if this site is severely deteriorated.

As the site begins to recover from a depleted condition, giant wildrye and the understory forage grasses show increased vigor, residue accumulates to protect the soil, and seedlings of perennial grasses become established.

Areas of soils in low, fair, and poor condition can be returned to optimum protection through seeding. If sod formers dominate, a prepared seedbed is important.

Giant wildrye is the major forage producing plant. In excellent condition total annual production is estimated at 2,800 pounds per acre in years of favorable moisture and 1,400 pounds in dry years. Usable production for cattle is about 2,600 pounds and 1,200 pounds. Growth of the major forage grasses begins about March 20 and ends about July 15.

Woodland [5]

This section contains information concerning the relationship between soils and trees. It includes interpretations of the soil survey to make it more useful for landowners and operators in developing and carrying out plans for establishment and management of tree crops.

The principal forest cover (7) includes stands of interior Douglas-fir; interior ponderosa pine; lodgepole pine; ponderosa pine, larch, and Douglas-fir; grand fir, larch, and Douglas-fir; and western juniper.

Grazable woodland sites

Understory vegetation in woodland is the product of the soil, topography, climate, competing vegetation, and use. In this survey area, south facing slopes and other less favorable sites can have good stands of bunchgrasses or sedges because of the open tree canopy. Areas at a higher elevation that have north facing slopes and a dense canopy have a sparse understory of shade tolerant forbs and grasses.

Grazing of understory plants is compatible with timber management if it is controlled in a manner that maintains or enhances both timber and forage resources. Principles discussed in the range section are applicable, but several other factors affect forage production and grazing use. Tree spacing and canopy cover strongly influence both the composition and productivity of the understory. As shade cast by tree

[5] JAMES T. BEENE, forester, and ALAN V. BAHN, soil conservationist, Soil Conservation Service, assisted in the preparation of this section.

canopies increases, productivity decreases and species that are not shade tolerant decrease. When forest cover is cut or burned, maximum forage production can occur for a number of years under proper treatment and management. Seeding suited forage and erosion control species are attractive alternatives under these conditions. Wildlife cover and forage needs can benefit by carefully planning for this or any other type of forest improvement program.

Woodland groups

The soils of the survey area have been grouped according to their suitability for woodland use and management. Each woodland group is identified by a three-part ordination symbol, such as 4o1, 4x1, or 4x2. The potential productivity of the soils in the group is indicated by the first number in the symbol: 1, very high; 2, high; 3, moderately high; 4, moderate; and 5, low. These ratings, related to site index, are based on pertinent research, measurements by foresters and soil scientists, and experience by forest land managers. Site index is the average height, in fact, of the dominant and codominant trees at a specified age; 100 years for ponderosa pine (*7*); 50 years for Douglas-fir (*4*). The site index value for each mapping unit as shown in table 5 is an arithmetic mean, not an exact rating as might be implied. The variation in the site index value for a mapping unit can be as great as 10 to 15 feet. This is caused by many factors including soil depth, amount of coarse fragments in the rooting zone, precipitation, position on slope, direction of exposure on sloping land, length of growing season, and many others. The rating shown for each mapping unit is believed to be at about the middle of this range. Conversions of average site index into growth in board feet and yield can be made by referring to table 3 or 4. In table 4, data for mean annual board-feet increments were extrapolated from ponderosa pine values (*10*).

The second part of the symbol identifying a woodland group is a small letter. In this survey, x, d, f, r, and o are used. Except for the o, the small letter indicates an important soil property that imposes a hazard or limitation in managing the soils of the group for woodland. The letter *o* shows that the soils have slight or no limitations. The letter *x* means that a hazard or limitation is caused by stones on the soil surface. The letter *d* means that the soils are shallow (less than 20 inches). The letter *f* means that the soils have restrictions or limitations for woodland use or management because of large amounts of coarse fragments in the profile. The letter *r* shows that the main limitation is steep slopes and that there is hazard of erosion and use of equipment is limited in places.

The last part of the symbol, another number, differentiates woodland groups that have identical first and second parts in their identifying symbol but have different species suitability or require different management.

In this survey the usable production on pounds per acre is the amount of herbage available to and readily grazed by cattle, but it is not to be construed as proper grazing use for the site.

In table 5 each mapping unit in the area is rated for various management hazards or limitations. These ratings are *slight, moderate,* and *severe.* They are described in the following paragraphs.

Erosion hazard is based on steepness of slope, soil depth, and erodibility of the soil. The hazard is *slight* where gentle to moderate slopes and slow to medium runoff make erosion control negligible. The hazard is *moderate* where moderately steep to steep slopes having rapid runoff make erosion-control practices essential to prevent unnecessary erosion. The hazard is *severe* where very steep slopes and very rapid runoff necessitate intensive erosion-control practices, or specialized equipment and care in logging operations are needed to minimize soil disturbance.

TABLE 3.—*Mean annual growth of interior Douglas-fir by age, productivity class, and site index*

[Mean annual board-feet increment (Scribner rule) per acre of trees 11.6 inches and more in diameter]

Age	Productivity class and site index			
	Class 5	Class 4	Class 3	Class 2
	Site index 50	Site index 60	Site index 70	Site index 80
Years				
20				5
30			20	83
40	2	22	78	188
50	13	57	142	280
60	34	98	200	350
70	58	136	245	397
80	84	168	278	428
90	106	194	302	447
100	126	212	317	458

TABLE 4.—*Mean annual growth of ponderosa pine by age, productivity class, and site index*

[Mean annual board-feet increment (*10*) (Scribner rule) per acre of trees 11.6 inches and more in diameter]

Age	Productivity class and site index					
	Class 5		Class 4	Class 3		Class 2
	Site index 60	Site index 70	Site index 80	Site index 90	Site index 100	Site index 110
Years						
20						5
30				7	33	83
40		2	15	48	108	188
50	2	14	46	100	184	280
60	10	37	85	152	247	350
70	26	61	121	197	293	397
80	44	88	152	231	325	428
90	61	111	178	256	347	447
100	78	131	197	272	361	458

TABLE 5.—*Woodland management and productivity*

[Only the soils suitable for production of commercial trees are listed in this table. Absence of an entry in a column means the information was not available]

Soil name and map symbol	Ordination symbol	Management concerns					Potential productivity	
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Important trees	Site index
Alding:								
[1] 1F:								
Alding part	5d1	Severe	Severe	Severe	Moderate	Moderate	Ponderosa pine	60
Rock outcrop part								
Lithic Xerochrepts part								
Daxty:								
7E	3f1	Moderate	Moderate	Moderate	Slight	Moderate	Ponderosa pine	85
							Douglas-fir	
[1] 8E:								
Daxty part	4f1	Moderate	Moderate	Severe	Slight	Moderate	Ponderosa pine	75
							Douglas-fir	
Rock outcrop part								
Lithic Xerochrepts part								
Hankins:								
19E	3o3	Severe	Moderate	Moderate	Moderate	Moderate	Ponderosa pine	95
							Douglas-fir	70
20E	4o1	Moderate	Moderate	Moderate	Slight	Slight	Ponderosa pine	75
Helter:								
21C, 21E	3o2	Slight	Moderate	Slight	Slight	Moderate	Western larch	
							Douglas-fir	75
							Grand fir	
							Ponderosa pine	
21F	3r3	Slight	Severe	Slight	Slight	Moderate	Western larch	
							Douglas-fir	75
							Grand fir	
							Ponderosa pine	
Laycock:								
[1] 22E:								
Laycock part	3f1	Moderate	Slight	Moderate	Moderate	Moderate	Ponderosa pine	85
							Douglas-fir	
Logdell part								
[1] 23E:								
Laycock part	4f1	Moderate	Slight	Severe	Moderate	Moderate	Ponderosa pine	80
							Douglas-fir	
Logdell part								
[1] 23F:								
Laycock part	4f2	Severe	Moderate	Severe	Moderate	Moderate	Ponderosa pine	80
Logdell part								
Lemonex:								
24E	3o1	Moderate	Slight	Moderate	Moderate	Moderate	Ponderosa pine	80
							Douglas-fir	

TABLE 5.—*Woodland management and productivity*—Continued

Soil name and map symbol	Ordination symbol	Management concerns					Potential productivity	
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Important trees	Site index
Lemonex cont:								
[1] 25E:								
Lemonex part	4x1	Moderate	Moderate	Moderate	Moderate	Moderate	Ponderosa pine	75
Rock outcrop part								
Lithic Xerochrepts part								
McGarr:								
28E	3o1	Moderate	Slight	Moderate	Slight	Moderate	Ponderosa pine Douglas-fir	85
[1] 28F	3r2	Severe	Severe	Severe	Moderate	Moderate	Ponderosa pine Douglas-fir	85
[1] 29F:								
McGarr part	4x1						Ponderosa pine	75
Anatone part								
Piersonte:								
[1] 33F:								
Piersonte part	3f2	Severe	Severe	Moderate	Slight	Moderate	Ponderosa pine Douglas-fir	85 70
Logdell part								
Laycock part	3f2	Severe	Moderate	Moderate	Moderate	Moderate	Ponderosa pine Douglas-fir	85 70
Rock outcrop:								
[1] 36F:								
Rock outcrop part								
Lemonex part	4x2	Severe	Moderate	Moderate	Moderate	Moderate	Ponderosa pine	80
Lithic Xerochrepts part								
Ruddley:								
[1] 38E	4d2	Moderate	Slight	Moderate	Moderate	Moderate	Ponderosa pine	75
[1] 39E:								
Ruddley part	4d1	Moderate	Slight	Moderate	Moderate	Moderate	Ponderosa pine	75
Rock outcrop part								
Lithic Xerochrepts part								
Top:								
47E	3o3	Slight	Slight	Moderate	Moderate	Moderate	Ponderosa pine Douglas-fir	95 70
47F	3r1	Severe	Moderate	Moderate	Moderate	Moderate	Ponderosa pine Douglas-fir	95 70

[1] This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

Considered in the ratings of *equipment limitations* are soil characteristics and topographic features that restrict or prohibit the use of conventional equipment in road construction, fire control, tree planting, timber stand improvement, or harvesting of forest products. Stoniness, slope steepness, excessive clay in the surface layer, or soil instability when wet are examples of equipment limitations.

Seedling mortality refers to mortality of naturally occurring or planted tree seedlings, as influenced by kinds of soil or topographic conditions when plant competition is not a factor. *Slight* means a loss of 0 to 25 percent of the seedlings is expected; *moderate* means a loss of 25 to 50 percent; and *severe* means a loss of more than 50 percent is expected. It is assumed that quality planting stock is used or seed sources are adequate.

Considered in the ratings of *windthrow hazard* are characteristics of the soil that affect the development of tree roots and the ability of soil to hold trees firmly. A rating of *slight* indicates that trees in wooded areas are not expected to be blown down by commonly occurring winds; *moderate,* that some trees are blown down during periods of excessive soil wetness and strong winds; and *severe,* that many trees are blown down during periods of excessive soil wetness and moderate or strong winds.

Plant competition is the degree to which undesirable plants invade openings in the tree canopy. Considered in the ratings are available water capacity, fertility, drainage, and degree of erosion. *Slight* means that plant competition does not prevent adequate natural regeneration and early growth or interfere with seedling development. *Moderate* means that competition delays natural or artificial establishment and growth rate, but does not prevent the development of fully stocked normal stands. *Severe* means that competition prevents adequate natural or artificial regeneration unless the site is prepared properly and a maintenance practice, such as weeding, is used.

The *potential productivity* of merchantable or *important trees* on a soil is expressed as a *site index.* This index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even aged, unmanaged stands.

WOODLAND GROUP 3f1

This group consists of well drained soils of the Laycock and Daxty series. These soils have a surface layer of loam or very stony loam. They are on uplands and have north facing slopes of 15 to 45 percent. These soils formed in colluvium weathered from platy volcanic tuff or in very shaly colluvium weathered from fractured shale. Elevation is 3,500 to 5,500 feet. The average annual precipitation is 17 to 24 inches, and the average annual air temperature is 40° to 45° F.

Runoff is medium to rapid, and the hazard of erosion is moderate to severe. Permeability is moderate, available water capacity is 2 to 5 inches, and the water supplying capacity is 9 to 14 inches. Roots penetrate to a depth of 20 to 40 inches.

The soils in this group have moderately high potential productivity. Seedling mortality is moderate, and plant competition delays seedling establishment and growth at times.

These soils generally are well suited to ponderosa pine and Douglas-fir.

In areas where a mixed stand of pine and fir originally occupied the overstory, the understory is dominated by elk sedge. Pine grass, sod-bluegrass, and perennial forbs such as geranium, strawberry, heartleaf arnica, and yarrow are present. Shrubs such as bitterbrush, rose, spirea, snowberry, or Oregon-grape occur. If deterioration occurs, elk sedge decreases and sod-bluegrass and forbs strongly increase. If deterioration is severe, shrubs and unpalatable forbs become prominent.

The estimated composition of the original understory community by percentage of total weight is elk sedge, 55 percent; pinegrass, 10 percent; Idaho fescue, 5 percent; forbs, 10 percent; and shrubs, 20 percent. In excellent condition, under a 50 to 60 percent canopy, total annual production of the understory is estimated at 750 pounds in years of favorable moisture and 500 pounds in dry years. Usable production for cattle is about 600 pounds and 400 pounds, respectively.

WOODLAND GROUP 3f2

This group consists of well drained Piersonte and Laycock soils. These soils have a surface layer of shaly loam or very shaly loam. They are on uplands and have north facing slopes of 45 to 70 percent. These soils formed in colluvium weathered from shale. Elevation is 3,500 to 5,500 feet. The average annual precipitation is 17 to 22 inches, and the average annual air temperature is 40° to 45° F.

Runoff is medium to rapid, and the hazard of erosion is moderate to severe. Permeability is moderate, available water capacity is 2 to 6 inches, and the water supplying capacity is 10 to 14 inches. Roots penetrate to a depth of 40 to 60 inches.

The soils in this group have moderately high potential productivity. Equipment limitations are moderate to severe, and seedling mortality is moderate. Plant competition may delay seedling establishment and growth.

These soils generally are better suited to Douglas-fir than to other trees, because their slopes face north. They are also suited to ponderosa pine, especially at lower elevations where precipitation drops below 20 inches in some years.

In areas where a mixed stand of pine and fir originally occupied the overstory, the understory is dominated by elk sedge. Pine grass, sod-bluegrass, and perennial forbs such as geranium, strawberry, heartleaf arnica, and yarrow are present. Shrubs such as bitterbrush, rose, spirea, snowberry, and Oregon-grape occur. If deterioration occurs, elk sedge decreases and sod-bluegrass and forbs strongly increase. If deterioration is severe, shrubs and unpalatable forbs become prominent.

The estimated composition of the original understory community by percentage of total weight is elk sedge, 55 percent; pinegrass, 10 percent; Idaho fescue, 5 percent; forbs, 10 percent; and shrubs, 20 percent. In excellent condition, under a 50 to 60 percent canopy, total annual production of the understory is estimated

at 750 pounds in years of favorable moisture and 500 pounds in dry years. Usable production for cattle is about 600 pounds and 400 pounds, respectively.

WOODLAND GROUP 3r1

Top silt loam, 35 to 65 percent slopes, is the only soil in this group. It generally is on north facing slopes. It formed in loess and in colluvium from basalt on uplands. Elevation is 3,500 to 5,000 feet. The average annual precipitation is 17 to 24 inches, and the average annual air temperature is 40° to 45° F.

Runoff is medium to rapid, and the hazard of erosion is severe. Permeability is moderately slow, available water capacity is 8 to 12 inches, and the water supplying capacity is 13 to 17 inches. Roots penetrate to a depth of 40 to 60 inches or more.

The soils in this group have moderately high potential productivity. Equipment limitations are moderate, and plant competition delays seedling establishment and growth at times.

These soils generally are better suited to ponderosa pine if annual precipitation is less than 20 inches; if precipitation exceeds 20 inches, Douglas-fir and ponderosa pine are suited; suited species include grand fir.

In areas where a mixed stand of pine and fir originally occupied the overstory, the understory is dominated by elk sedge. Pine grass, sod-bluegrass, and perennial forbs such as geranium, strawberry, heartleaf arnica, and yarrow are present. Shrubs such as bitterbrush, rose, spirea, snowberry, and Oregon-grape occur. If deterioration occurs, elk sedge decreases and sod-bluegrass and forbs strongly increase. If deterioration is severe, shrubs and unpalatable forbs become prominent.

The estimated composition of the original understory community by percentage of total weight is elk sedge, 55 percent; pinegrass, 10 percent; Idaho fescue, 5 percent; forbs, 10 percent; and shrubs, 20 percent. In excellent condition, under a 50 to 60 percent canopy, total annual production of the understory is estimated at 750 pounds in years of favorable moisture and 500 pounds in dry years. Usable production for cattle is about 600 pounds and 400 pounds, respectively.

WOODLAND GROUP 3r2

McGarr stony loam, 45 to 75 percent slopes, is the only soil in this group. It is a well drained soil on uplands. Slopes generally face to the north. Elevation ranges from 3,500 to 5,500 feet. The average annual precipitation is 17 to 25 inches, and the average annual air temperature is 40° to 45° F.

Runoff is rapid, and the hazard of erosion is severe. Permeability is moderately slow, available water capacity is 3 to 7 inches, and the water supplying capacity is 13 to 17 inches. Roots penetrate to a depth of 20 to 40 inches.

These soils have moderately high potential productivity. Erosion hazard and equipment limitations are severe. Seedling mortality and plant competition are moderate.

These soils generally are well suited to ponderosa pine and Douglas-fir.

In areas where a mixed stand of pine and fir originally occupied the overstory, the understory is dominated by elk sedge. Pine grass, sod-bluegrass, and perennial forbs such as geranium, strawberry, heartleaf arnica, and yarrow are present. Shrubs such as bitterbrush, rose, spirea, snowberry, and Oregon-grape occur. If deterioration occurs, elk sedge decreases and sod-bluegrass and forbs strongly increase. If deterioration is severe, shrubs and unpalatable forbs become prominent.

The estimated composition of the original understory community by percentage of total weight is elk sedge, 55 percent; pinegrass, 10 percent; Idaho fescue, 5 percent; forbs, 10 percent; and shrubs, 20 percent. In excellent condition, under a 50 to 60 percent canopy, total annual production of the understory is estimated at 750 pounds in years of favorable moisture and 500 pounds in dry years. Usable production is about 600 pounds and 400 pounds, respectively.

WOODLAND GROUP 3r3

Helter silt loam, 40 to 60 percent slopes, is the only soil in this group. Slopes generally face north. This well drained soil formed in volcanic ash, loess, and residuum weathered from basalt on uplands. Elevation is 4,500 to 5,500 feet. The average annual precipitation is 22 to 30 inches, and the average annual air temperature is 40° to 44° F.

Runoff is rapid, and the hazard of erosion is severe. Permeability is moderately slow, available water capacity is 10 to 20 inches, and the water supplying capacity is 15 to 20 inches. Roots penetrate to a depth of 40 to 60 inches.

The soils in this group have moderately high potential productivity. Equipment limitations are moderate, and plant competition may delay seedling establishment and growth.

These soils are generally well suited to Douglas-fir, grand fir, western larch, lodgepole pine, and occasional ponderosa pine.

In areas where a mixture of grand fir and Douglas-fir originally occupied the overstory, the understory consists of a sparse stand of shade tolerant plants such as arnica, twinflower, trillium, bedstraw, and Solomon-plume. The midstory is composed of tree reproduction and shrubs such as serviceberry, maple, willow, and ninebark. Forage production is minor in terms of yield. If the canopy is opened, considerable forage can be produced for a number of years by seeding adapted grasses and forbs. Shrubs and forbs naturally increase over a period of time under these conditions.

WOODLAND GROUP 3o1

This group consists of well drained Lemonex and McGarr soils. These soils have a surface layer of stony clay loam or stony loam. They formed in mixed colluvium and in residuum weathered from basalt or serpentine bedrock. They are on uplands and generally are on north facing slopes of 5 to 45 percent. Elevation is 3,500 to 5,500 feet. The average annual precipitation is 17 to 25 inches, and the average annual air temperature is 40° to 45° F.

Runoff is medium to rapid, and the hazard of erosion is moderate to severe. Permeability is moderately slow to slow, available water capacity is 2 to 7 inches, and the water supplying capacity is 11 to 17 inches. Roots penetrate to a depth of 20 to 40 inches.

The soils in this group have moderately high potential productivity. Equipment limitations are moderate to severe, and seedling mortality and plant competition are moderate.

These soils generally are well suited to ponderosa pine and Douglas-fir.

In areas where a mixed stand of pine and fir originally occupied the overstory, the understory is dominated by elk sedge. Pinegrass, sod-bluegrass, and perennial forbs such as geranium, strawberry, heartleaf arnica, and yarrow are present. Shrubs such as bitterbrush, rose, spirea, snowberry, and Oregon-grape occur. If deterioration occurs, elk sedge decreases and sod-bluegrass and forbs strongly increase. If deterioration is severe, shrubs and unpalatable forbs become prominent.

The estimated composition of the original understory community by percentage of total weight is elk sedge, 55 percent; pinegrass, 10 percent; Idaho fescue, 5 percent; forbs, 10 percent; and shrubs, 20 percent. In excellent condition, under a 50 to 60 percent canopy, total annual production of the understory is estimated at 750 pounds in years of favorable moisture and 500 pounds in dry years. Usable production for cattle is about 600 pounds and 400 pounds, respectively.

WOODLAND GROUP 3o2

This group consists of Helter soils. Slopes are 3 to 40 percent. These soils are on ridgetops or on north facing slopes. They are well drained, and they formed in volcanic ash, loess, and in residuum weathered from basalt on uplands. Elevation is 4,500 to 5,500 feet. The average annual precipitation is 22 to 30 inches, and the average annual air temperature is 40° to 44° F.

Runoff is slow, and the hazard of erosion is moderate. Permeability is moderately slow, available water capacity is 10 to 20 inches, and the water supplying capacity is 15 to 20 inches. Roots penetrate to a depth of 40 to 60 inches.

The soils in this group have moderately high potential productivity. Plant competition delays seedling establishment and growth at times.

These soils generally are well suited to Douglas-fir, western larch, grand fir, lodgepole pine, and occasional ponderosa pine (fig. 9).

In areas where a mixture of grand fir and Douglas-fir originally occupied the overstory, the understory consists of a sparse stand of shade tolerant plants such as arnica, twinflower, trillium, bedstraw, and Solomon-plume. The midstory is composed of tree reproduction and shrubs such as serviceberry, maple,

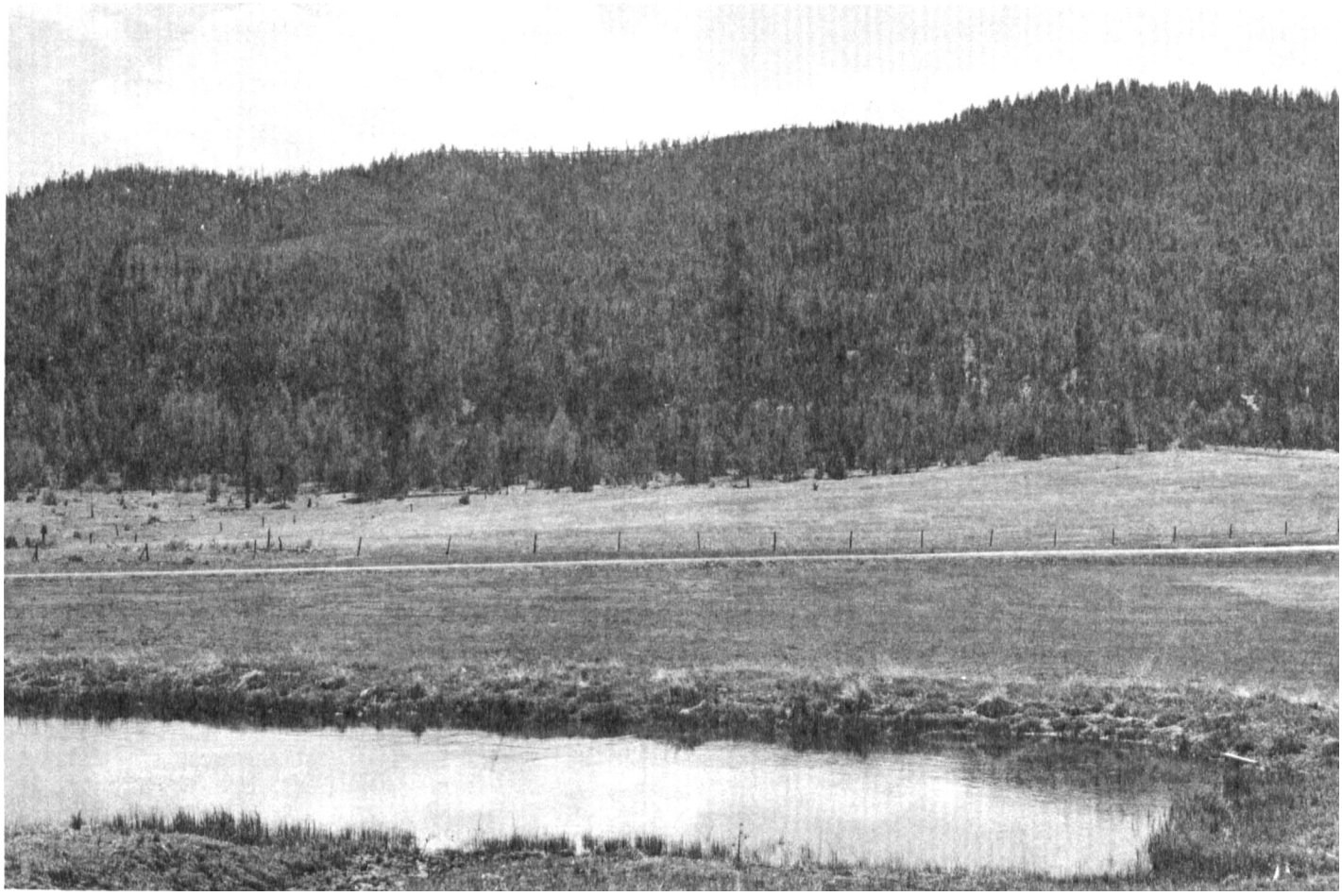

Figure 9.—**Timber growing on an area of Helter silt loam, 15 to 40 percent slopes.**

willow, and ninebark. Forage production is minor in terms of yield. If the canopy is opened, considerable forage can be produced for a number of years by seeding suited grasses and forbs. Shrubs and forbs naturally increase over a period of time under these conditions.

WOODLAND GROUP 3o3

This group consists of well drained Top and Hankins soils. These soils have a surfaced layer of silt loam. The Top soils formed in loess and in colluvium derived from basalt on uplands. The Hankins soils formed in old waterlaid sediment on uplands. These soils have slopes that range from 10 to 45 percent and are generally north facing. Elevation is 3,500 to 5,000 feet. The average annual precipitation is 16 to 25 inches, and the average annual air temperature is 40° to 45° F.

Runoff is medium to rapid, and the hazard of erosion is severe. Permeability is moderately slow to slow, available water capacity is 3 to 12 inches, and the water supplying capacity is 13 to 17 inches. The effective rooting depth is 20 to 60 inches or more.

The soils in this group have moderately high potential productivity. Plant competition delays seedling establishment and growth at times.

These soils generally are suited to ponderosa pine if annual precipitation is less than 20 inches. If precipitation is more than 20 inches, they are suited to Douglas-fir and pondersoa pine. They are also suited to grand fir.

In areas where a mixed stand of pine and fir originally occupied the overstory, the understory is dominated by elk sedge. Pinegrass, sod-bluegrass, and perennial forbs such as geranium, strawberry, heartleaf arnica, and yarrow are present. Shrubs such as bitterbrush, rose, spirea, snowberry, and Oregon-grape occur. If deterioration occurs, elk sedge decreases and sod-bluegrass and forbs strongly increase. If deterioration is severe, shrubs and unpalatable forbs become prominent.

The estimated composition of the original understory community by percentage of total weight is elk sedge, 55 percent; pinegrass, 10 percent; Idaho fescue, 5 percent; forbs, 10 percent; and shrubs, 20 percent. In excellent condition, under a 50 to 60 percent canopy, total annual production of the understory is estimated at 750 pounds in years of favorable moisture and 500 pounds in dry years. Usable production for cattle is about 600 pounds and 400 pounds, respectively.

WOODLAND GROUP 4x1

This group consists of well drained Lemonex and McGarr soils. These soils have a surface layer of very stony loam or very stony clay loam. They are on uplands, and they generally have south facing slopes of 3 to 65 percent. The Lemonex soils formed in mixed colluvium and in residuum weathered mostly from serpentine bedrock. The McGarr soils formed in loess and in colluvium derived from basalt. Elevation is 3,500 to 5,500 feet. The average annual precipitation is 17 to 25 inches, and the average annual air temperature is 40° to 45° F.

Runoff is medium to rapid, and the hazard of erosion is moderate to severe. Permeability is moderately slow or slow, available water capacity is 2 to 7 inches, and the water supplying capacity is 11 to 17 inches. Roots penetrate to a depth of 20 to 40 inches.

The soils in this group have moderate potential productivity. The erosion hazard is severe on slopes of more than 15 percent. Equipment limitations are moderate, and seedling mortality, generally moderate, is severe on southwesterly exposures. Plant competition is moderate.

These soils generally are suited to ponderosa pine, but Douglas-fir is at higher elevations where annual precipitation is more than 20 inches.

In areas where pine originally occupied the overstory, the understory is dominated by elk sedge. Idaho fescue, pinegrass, sod-bluegrass, and a variety of forbs such as heartleaf arnica, redball avens, buckwheat, and cinquefoil are present. Small amounts of shrubs such as bitterbrush, snowberry, and wax currant occur. If deterioration occurs, elk sedge decreases and perennial forbs and sod-bluegrass increase. If deterioration is severe, unpalatable forbs, annuals, and shrubs become prominent.

The estimated composition of the original understory community by percentage of total weight is elk sedge, 45 percent; Idaho fescue, 20 percent; pinegrass, 5 percent; perennial forbs, 15 percent; and shrubs, 15 percent. In excellent condition, under a 15 to 40 percent canopy, total annual production is estimated at 1,000 pounds in years of favorable moisture and 700 pounds in dry years. Usable production for cattle is about 750 pounds and 500 pounds, respectively.

WOODLAND GROUP 4x2

Lemonex very stony clay loam, 30 to 75 percent slopes, is the only soil in this group. It is on uplands, and it generally has south facing slopes. This soil formed in mixed colluvium and in residuum weathered mostly from serpentine bedrock. Elevation is 3,800 to 5,500 feet. The average annual precipitation is 17 to 24 inches, and the average annual air temperature is 40° to 45° F.

Runoff is rapid, and the hazard of erosion is severe. Permeability is slow, available water capacity is 2 to 5 inches, and the water supplying capacity is 11 to 14 inches. Roots penetrate to a depth of 20 to 40 inches.

The soils in this group have moderate potential productivity. Erosion hazard and equipment limitations are severe. Seedling mortality is mainly moderate, but it is severe on southwesterly exposures. Plant competition is moderate.

These soils generally are suited to ponderosa pine, but Douglas-fir grows at higher elevations where annual precipitation exceeds 20 inches.

In areas where pine originally occupied the overstory, the understory is dominated by elk sedge. Idaho fescue, pinegrass, sod-bluegrass, and a variety of forbs such as heartleaf arnica, redball avens, buckwheat, and cinquefoil are present. Small amounts of shrubs such as bitterbrush, snowberry, and wax currant are present. If deterioration occurs, elk sedge decreases and perennial forbs and sod-bluegrass increase. If deterioration is severe, unpalatable forbs, annuals, and shrubs become prominent.

The estimated composition of the original under-

story community by percentage of total weight is elk sedge, 45 percent; Idaho fescue, 20 percent; pinegrass, 5 percent; perennial forbs, 15 percent; and shrubs, 15 percent. In excellent condition, under a 15 to 40 percent canopy, total annual production of the understory is estimated at 1,000 pounds in years of favorable moisture and 700 pounds in dry years. Usable production for cattle is about 750 pounds and 500 pounds, respectively.

WOODLAND GROUP 4d1

Ruddley loam, 5 to 40 percent slopes, is the only soil in this group. This well drained soil generally has south facing slopes. It formed in colluvium weathered from metavolcanic rock on uplands. Elevation is 4,000 to 5,500 feet. The average annual precipitation is 17 to 24 inches, and the average annual air temperature is 41° to 45° F.

Runoff is medium, and the hazard of erosion is severe. Permeability is moderately slow, available water capacity is 2 to 4 inches, and the water supplying capacity is 9 to 12 inches. Roots penetrate to a depth of 12 to 20 inches.

This soil has moderate potential productivity, and equipment limitations are slight to moderate. Seedling mortality is generally moderate, but it is severe on southwesterly exposures. Moderate plant competition delays seedling establishment and growth at times.

These soils are suited to ponderosa pine if annual precipitation is less than 20 inches. Douglas-fir grows in places if precipitation is more than 20 inches.

In areas where pine originally occupied the overstory, the understory is dominated by elk sedge. Idaho fescue, pinegrass, sod-bluegrass, and a variety of forbs such as heartleaf arnica, redball avens, buckwheat, and cinquefoil are present. Small amounts of shrubs such as bitterbrush, snowberry, and wax currant occur. If deterioration occurs, elk sedge decreases and perennial forbs and sod-bluegrass increase. If deterioration is severe, unpalatable forbs, annuals, and shrubs become prominent.

The estimated composition of the original understory community by percentage of total weight is elk sedge, 45 percent; Idaho fescue, 20 percent; pinegrass, 5 percent; perennial forbs, 15 percent; and shrubs, 15 percent. In excellent condition, under a 15 to 40 percent canopy, total annual production of the understory is estimated at 1,000 pounds in years of favorable moisture and 700 pounds in dry years. Usable production for cattle is about 750 pounds and 500 pounds, respectively.

WOODLAND GROUP 4d2

Ruddley loam, 5 to 40 percent slopes, is the only soil in this group. This north facing soil is well drained. It formed in colluvium weathered from metavolcanic rock on uplands. Elevation is 4,000 to 5,500 feet. The average annual precipitation is 17 to 24 inches, and the average annual air temperature is 41° to 45° F.

Runoff is medium to rapid, and the hazard of erosion is moderate to severe. Permeability is moderately slow, available water capacity is 2 to 4 inches, and the water supplying capacity is 9 to 12 inches. Roots penetrate to a depth of 12 to 20 inches.

This soil has moderate potential productivity. Equipment limitations are moderate, and seedling mortality is moderate because of the shallow soil. Plant competition delays seedling establishment and growth at times.

This soil generally is suited to ponderosa pine, but it is suited to Douglas-fir if annual precipitation is more than 20 inches.

In areas where a mixed stand of pine and fir originally occupied the overstory, the understory is dominated by elk sedge. Pinegrass, sod-bluegrass, and perennial forbs such as geranium, strawberry, heartleaf arnica, and yarrow are present. Shrubs such as bitterbrush, rose, spirea, snowberry, and Oregon-grape occur. If deterioration occurs, elk sedge decreases and sod-bluegrass and forbs strongly increase. If deterioration is severe, shrubs and unpalatable forbs become prominent.

The estimated composition of the original understory community by percentage of total weight is elk sedge, 55 percent; pinegrass, 10 percent; Idaho fescue, 5 percent; forbs, 10 percent; and shrubs, 20 percent. In excellent condition, under a 50 to 60 percent canopy, total annual production of the understory is estimated at 750 pounds in years of favorable moisture and 500 pounds in dry years. Usable production for cattle is about 600 pounds and 400 pounds, respectively.

WOODLAND GROUP 4f1

This group consists of well drained Daxty and Laycock soils. These soils have a surface layer of very flaggy or very shaly loam. They are on uplands, and they generally have south facing slopes of 3 to 45 percent. The Daxty soils formed in colluvium weathered from platy volcanic tuff. The Laycock soils formed in very shaly colluvium weathered from fractured shale. Elevation is 3,500 to 5,500 feet. The average annual precipitation is 17 to 24 inches, and the average annual air temperature is 40° to 45° F.

Runoff is medium to rapid, and the hazard of erosion is moderate to severe. Permeability is moderate, available water capacity is 1.8 to 5 inches, and the water supplying capacity is 9 to 14 inches. Roots penetrate to a depth of 20 to 40 inches.

The soils in this group have moderate potential productivity. Equipment limitations are slight to moderate; seedling mortality is moderate. Plant competition delays establishment and growth of tree seedlings at times.

These soils generally are suited to ponderosa pine. Douglas-fir occurs at higher elevations where annual precipitation is more than 20 inches.

In areas where pine originally occupied the overstory, the understory is dominated by elk sedge. Idaho fescue, pinegrass, sod-bluegrass, and a variety of forbs such as heartleaf arnica, redball avens, buckwheat, and cinquefoil are present. Small amounts of shrubs such as bitterbrush, snowberry, and wax currant are present. If deterioration occurs, elk sedge decreases and perennial forbs and sod-bluegrass increase. If deterioration is severe, unpalatable forbs, annuals, and shrubs become prominent.

The estimated composition of the original understory community by percentage of total weight is elk sedge, 45 percent; Idaho fescue, 20 percent; pinegrass, 5 percent; perennial forbs, 15 percent; and shrubs,

15 percent. In excellent condition, under a 15 to 40 percent canopy, total annual production of the understory is estimated at 1,000 pounds in years of favorable moisture and 700 pounds in dry years. Usable production for cattle is about 750 pounds and 500 pounds, respectively.

WOODLAND GROUP 4f2

Laycock very shaly loam, 45 to 75 percent south slopes, is the only soil in this group. This well drained soil formed in very shaly colluvium weathered from fractured shale on uplands. Elevation is 3,500 to 5,500 feet. The average annual precipitation is 17 to 22 inches, and the average annual air temperature is 40° to 45° F.

Runoff is rapid, and the hazard of erosion is severe. Permeability is moderate, available water capacity is 2 to 4 inches, and the water supplying capacity is 10 to 14 inches. Roots penetrate to a depth of about 40 inches.

This soil has moderate potential productivity. Equipment limitations are moderate to severe, and seedling mortality, generally moderate, is severe on southwesterly exposures. Plant competition is moderate.

This soil generally is suited to ponderosa pine. Douglas-fir occurs at higher elevations where annual precipitation is more than 20 inches.

In areas where pine originally occupied the overstory, the understory is dominated by elk sedge. Idaho fescue, pinegrass, sod-bluegrass, and a variety of forbs such as heartleaf arnica, redball avens, buckwheat, and cinquefoil are present. Also, small amounts of shrubs such as bitterbrush, snowberry, and wax currant are present. If deterioration occurs, elk sedge decreases and perennial forbs and sod-bluegrass increase. If deterioration is severe, unpalatable forbs, annuals, and shrubs become prominent.

The estimated composition of the original understory community by percentage of total weight is elk sedge, 45 percent; Idaho fescue, 20 percent; pinegrass, 5 percent; perennial forbs, 15 percent; and shrubs, 15 percent. In excellent condition, under a 15 to 40 percent canopy, total annual production of the understory is estimated at 1,000 pounds in years of favorable moisture and 700 pounds in dry years. Usable production for cattle is about 750 pounds and 500 pounds, respectively.

WOODLAND GROUP 4o1

Hankins silty clay loam, 5 to 35 percent slopes, is the only soil in this group. This soil is well drained, and it generally has south facing slopes. It formed in old waterlaid sediment on uplands. Elevation is 3,500 to 5,000 feet. The average annual precipitation is 16 to 25 inches, and the average annual air temperature is 40° to 45° F.

Runoff is medium to rapid, and the hazard of erosion is moderate to severe. Permeability is slow, available water capacity is 3 to 7 inches, and the water supplying capacity is 13 to 16 inches. Roots penetrate to a depth of 20 to 40 inches.

The soils in this group have moderate potential productivity. Seedling mortality is moderate.

These soils are suited to ponderosa pine if annual precipitation is less than 20 inches; if precipitation is more than 20 inches, Douglas-fir also occurs in places.

In areas where pine originally occupied the overstory, the understory is dominated by elk sedge. Idaho fescue, pinegrass, sod-bluegrass, and a variety of forbs such as heartleaf arnica, redball avens, buckwheat, and cinquefoil are present. Small amounts of shrubs such as bitterbrush, snowberry, and wax currant occur. If deterioration occurs, elk sedge decreases and perennial forbs and sod-bluegrass increase. If deterioration is severe, unpalatable forbs, annuals, and shrubs become prominent.

The estimated composition of the original understory community by percentage of total weight is elk sedge, 45 percent; Idaho fescue, 20 percent; pinegrass, 5 percent; perennial forbs, 15 percent; and shrubs, 15 percent. In excellent condition, under a 15 to 40 percent canopy, total annual production of the understory is estimated at 1,000 pounds in years of favorable moisture and 700 pounds in dry years. Usable production for cattle is about 750 pounds and 500 pounds, respectively.

WOODLAND GROUP 5d1

Alding gravelly loam, 30 to 70 percent slopes, is the only soil in this group. This soil is well drained, and it generally has south facing slopes. It formed in colluvium from weathered metavolcanic rock on uplands. Elevation is 3,800 to 5,500 feet. The average annual precipitation is 17 to 24 inches, and the average annual air temperature is 40° to 45° F.

Runoff is rapid, and the hazard of erosion is severe. Permeability is slow, available water capacity is 1 inch to 3 inches, and the water supplying capacity is 8 to 10 inches. Roots penetrate to a depth of 10 to 20 inches.

This soil has moderately low potential productivity. Equipment limitations and seedling mortality are severe, and plant competition is moderate.

This soil is generally suited to ponderosa pine. Western juniper is often an associated species.

In areas where pine originally occupied the overstory, the understory is dominated by Idaho fescue and bluebunch wheatgrass. Sandberg bluegrass, big bluegrass, and a variety of forbs such as yarrow, buckwheat, and lomatium are present. Small amounts of shrubs such as bitterbrush and snowberry are also present. If deterioration occurs, forage bunchgrasses decrease, annual grasses and unpalatable forbs become prominent, and big sagebrush and gray rabbitbrush invade.

The estimated composition of the original understory community by percentage of total weight is bluebunch wheatgrass, 40 percent; Idaho fescue, 30 percent; perennial forbs, 15 percent; and shrubs, 15 percent. In excellent condition, under a 10 to 30 percent canopy, total annual production for cattle is about 750 pounds in years of favorable moisture and 500 pounds in dry years.

Wildlife[6]

All of the soils of the survey area are suited to and

[6] ROBERT A. CORTHELL, biologist, Soil Conservation Service, helped prepare this section.

support habitat for one or more species of wildlife. The survey area is in an area roughly paralleling the John Day River and includes arid grassland, irrigated bottom land, and timbered upland.

Among the key wildlife areas in Grant County, Central Part, are the principal stream corridors that have good riparian vegetation; irrigated cropland; and dry, south facing rangeland at low elevation. These areas are heavily used in winter by migrating mule deer. High elevation timberland that provides good summer range for deer is also in the survey area.

The John Day River system produces anadromous chinook salmon, steelhead trout, and resident rainbow trout. Waterfowl and upland game birds are common along flood plains of this river system. Fur bearing animals such as beaver and muskrat are common. Many kinds of birds are abundant all year or are seasonally abundant. Some of the more important of these are hawks, golden eagle, owls, raven, magpie, and shore birds; insect eaters such as swallows, kingbird, and night hawk; and California quail, Hungarian partridge, ring-necked pheasant, and doves. Coyote, bobcat, raccoon, skunk, and badger depend on good populations of ground squirrels, rabbits, mice, and rats.

Wildlife groups

In the following paragraphs, soils that have similar characteristics for wildlife production have been placed into wildlife groups. These groups are briefly described as they relate to the various kinds of wildlife. The soils in each group can be determined by referring to the "Guide to Mapping Units" at the back of this survey.

The best potential for improving wildlife habitat is in wildlife groups 1 and 2 where land use decisions could include raising crops for wildlife food and cover. The potential for improving habitat in wildlife groups 3, 4, and 5 lies mostly in management of existing vegetation, especially livestock grazing.

WILDLIFE GROUP 1

This group consists of Boyce and Ricco soils. These soils are on the alluvial flood plain along the main fork of the John Day River. They are poorly drained soils that formed in recent alluvium. They have a black silty clay loam surface layer and a very dark gray silty clay loam subsoil. Boyce soils have very gravelly sand at a depth of 20 to 40 inches. Ricco soils are underlain by very gravelly sand at a depth of 40 to 60 inches or more. Slopes are 0 to 3 percent. Elevation is 2,200 to 4,000 feet. The vegetation is sedges, rushes, and tufted hairgrass.

The average annual precipitation is 12 to 16 inches, the average annual air temperature is 45° to 52° F, and the frost free period is 100 to 150 days.

Permeability is moderate to slow in these soils and available water capacity is 5 to 13 inches. Roots penetrate to a depth of 24 to 40 inches.

The native plant communities provide some of the most important wildlife habitat in Grant County. This habitat is basically the stream corridors and their associated riparian vegetation. Waterfowl, shore birds, furbearing animals, pheasants, and quail use the habitat all year; other wildlife, such as deer, bear, chukar, dove, and predatory birds and animals also use the habitat. The potential of these soils to produce more and better wildlife habitat is good. The John Day River produces some chinook salmon, steelhead trout, and rainbow trout.

WILDLIFE GROUP 2

This group consists of Courtrock, Dayville, Hack, Oxbow, Powder, and Veazie soils, all of which are irrigated. Dumps are in this group and occur mainly on bottom land. The soils in this group are on alluvial flood plains, low alluvial fans, and on old terraces. They are mainly well drained, but the Dayville soils are somewhat poorly drained. The soils formed in recent alluvium and old waterlaid material. The surface layer and subsoil are mainly loam to clay loam, but the Oxbow soils have a surface layer of very stony silty clay loam and a subsoil of clay. The soils are mainly underlain by very gravelly sand at a depth of 20 to 40 inches or more. The Oxbow soils, however, have a hardpan at a depth of 20 to 40 inches, and the Hack soils have a layer of lime at a depth of 20 to 40 inches. Slopes are 0 to 20 percent. Elevation is 2,100 to 4,200 feet. The vegetation is dominantly alfalfa, alfalfa-grass, grass, or grass-clover grown for hay and aftermath grazing by cattle.

The average annual precipitation is 10 to 18 inches, the average annual air temperature is 47° to 51° F, and the frost free period is 90 to 150 days.

Permeability is moderate to slow in these soils, and available water capacity is 3 to 12 inches. Roots penetrate to a depth of 20 to 40 inches or more.

These bottom land soils are presently being used for irrigated cropland, but they provide some of the habitat required for a variety of wildlife. The more important species are ring-necked pheasant, California quail, chukar, Hungarian partridge, doves, mice, squirrels, rabbits, coyote, badger, skunk, raccoon, hawks, owls, raven, magpie, flycatchers, and mule deer. The native plant community was rich in trees, shrubs, and grasses that provided good wildlife habitat. The potential is good for improving wildlife habitat by growing choice food and cover plants.

WILDLIFE GROUP 3

This group consists of Lickskillet, Day, and Simas soils. These soils are on uplands at a relatively low elevation. They are well drained, and they formed in colluvium derived from basalt, in waterlaid sediment, and in loess. They have a surface layer of extremely stony loam, stony clay loam, very stony clay loam, or clay and a subsoil of very gravelly clay loam or clay. Depth to hard bedrock is mainly more than 60 inches, but in the Lickskillet soils it is 10 to 20 inches. Elevation ranges from 2,100 to 4,000 feet, but it is dominantly 2,100 to 3,200 feet. The vegetation is bluebunch wheatgrass, Sandberg bluegrass, shrubs, and forbs.

The average annual precipitation is 10 to 14 inches; the average annual air temperature is 45° to 51° F, and the frost free period is 90 to 150 days.

Permeability is moderate to very slow in these soils, available water capacity is 1 inch to 9 inches, and the water supplying capacity is 2 to 12 inches. Roots penetrate to a depth of 12 to 60 inches.

These dry soils are mostly on south facing slopes.

They produce shrubs, grasses, forbs, and juniper trees that are not commonly very important to wildlife habitat. A large herd of wintering mule deer, however, migrates from as far as 80 miles away to use the vegetation for winter food and cover. Other common species, either in residence or in season, are chukar, rabbits, squirrels, coyote, bobcat, badger, hawks, owls, raven, robin, and magpie.

Better management, especially of livestock grazing, increases the potential for producing better wildlife habitat.

WILDLIFE GROUP 4

This group consists of Anatone, Balder, Fopiano, Grell, Gwin, Oxbow, Oxwall, Rockly, Snell, Tub, Ukiah, Venator, Waterbury, and Wrightman soils. These soils are on uplands, and they are well drained. They formed in residuum and colluvium from basalt, rhyolitic tuff, old waterlaid material, and shale. The surface layer of most of the soils contains some loess and volcanic ash. It is extremely stony to nonstony loam or silty clay loam. The subsoil is loam to clay. Content of rock fragments ranges from a few to about 75 percent. Depth to hard bedrock is mainly 20 to 60 inches or more, but in Anatone and Rockly soils it is 10 to 20 inches. Elevation ranges from 2,100 to 5,000 feet, but it is dominantly 3,200 to 5,000 feet. The vegetation is bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, big sagebrush, low sagebrush, and forbs.

The average annual precipitation ranges from 12 to about 20 inches, but it is dominantly 14 to 18 inches. The average annual air temperature is 42° to 51° F. The frost free period ranges from 10 to 150 days but is dominantly 20 to 100 days.

Permeability is moderate to slow in these soils, available water capacity is 1 inch to 11 inches, and the water supplying capacity is 5 to 12 inches. Roots penetrate mainly to a depth of 20 to more than 40 inches, but in Anatone, Oxwall, Rockly, and Waterbury soils, they penetrate to a depth of 10 to 20 inches.

Slopes of these dry soils are steep and face mainly to the south. Rocky rims are exposed in many places. The habitat is fair to good for mule deer, coyote, bobcat, mice, squirrels, hawks, raven, magpie, and chukar. The scabland areas mainly provide range for deer early in spring.

The potential for habitat improvement is limited in soils of this group.

WILDLIFE GROUP 5

This group consists of Alding, Anatone, Daxty, Hankins, Helter, Laycock, Lemonex, Logdell, McGarr, Piersonte, Ruddley, and Top soils and Lithic Xerochrepts. These soils are on uplands. They are well drained soils that formed in residuum and colluvium from rhyolitic tuff, shale, serpentine basalt, volcanic ash, and loess. The surface layer is gravelly loam, very gravelly loam, stony loam, clay loam, very stony loam, extremely stony loam, or silt loam. The subsoil is loam to clay and has a content of few to 70 percent rock fragments. Logdell and Laycock soils have a finely fractured shale subsoil. Depth to hard bedrock is mainly 20 to 60 inches or more, but in Alding soils it is 10 to 20 inches. Elevation ranges from 3,500 to 5,500 feet. Vegetation on the deeper soils is ponderosa pine, Douglas-fir, pinegrass, elk sedge, shrubs, and forbs. Helter soils have additional vegetation of white fir, western larch, and lodgepole pine. Vegetation on Lithic Xerochrepts is mountainmahogany, Idaho fescue, shrubs, and forbs.

The average annual precipitation is 17 to 30 inches, the average annual air temperature is 40° to 45° F, and the frost free period is 20 to about 60 days.

Permeability is moderate to slow. Available water capacity is mainly 2 to 12 inches, but in Helter soils it is 10 to 20 inches. The water supplying capacity is 9 to 20 inches. Roots penetrate mainly to a depth of 20 to 60 inches or more, but in Lithic Xerochrepts they penetrate to a depth of 5 to 15 inches.

These soils produce plant communities dominated by trees and a fair amount of shrubs and grasses. Seasonal habitat is good for a number of wildlife species including mule deer, black bear, coyote, bobcat, rabbits, squirrels, hawks, owls, raven, magpie, several kinds of small birds, and blue grouse.

The potential for increased wildlife production is good if management is good, especially management for livestock and woodland uses.

Wildlife habitat

Soils directly affect the kind and amount of vegetation that is available to wildlife as food and cover, and they affect the development of water impoundments. The kind and abundance of wildlife that populate an area depend largely on the amount and distribution of food, cover, and water. If any one of these elements is missing, inadequate, or inaccessible, wildlife either is scarce or does not inhabit the area.

If the soils have the potential, wildlife habitat can be created or improved by planting appropriate vegetation, by properly managing the existing plant cover, and by fostering the natural establishment of desirable plants.

In table 6 the soils in the survey area are rated according to their potential to support the main kinds of wildlife habitat in the area. This information can be used in—

1. Planning the use of parks, wildlife refuges, nature study areas, and other developments for wildlife.
2. Selecting soils that are suitable for creating, improving, or maintaining specific elements of wildlife habitat.
3. Determining the intensity of management needed for each element of the habitat.
4. Determining areas that are suitable for acquisition to manage for wildlife.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* means that the element of wildlife habitat or the kind of habitat is easily created, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected if the soil is used for the designated purpose. A rating of *fair* means that the element of wildlife habitat or kind of habitat can be created, improved, or maintained in most places. Moderate intensity of management and fairly frequent attention are required for satisfactory results. A rating of *poor* means that

limitations are severe for the designated element or kind of wildlife habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and requires intensive effort. A rating of *very poor* means that restrictions for the element of wildlife habitat or kind of wildlife are very severe and that unsatisfactory results can be expected. Wildlife habitat is impractical or even impossible to create, improve, or maintain on soils having such a rating.

The elements of wildlife habitat are briefly described in the following paragraphs.

Grain and seed crops are seed producing annuals used by wildlife. Examples are corn, sorghum, wheat, oats, barley, millet, buckwheat, cowpeas, soybeans, and sunflowers. The major soil properties that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and hazard of flooding. Soil temperature and moisture are also considerations.

Grasses and legumes are domestic perennial grasses and herbaceous legumes that are planted for wildlife food and cover. Examples are fescue, bluegrass, bromegrass, timothy, orchardgrass, clover, alfalfa, and trefoil. Major soil properties that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and moisture are also considerations.

Wild herbaceous plants are native or naturally established herbaceous grasses and forbs, including weeds, that provide food and cover for wildlife. Examples are cheatgrass, filaree, China lettuce, biscuitroot, Idaho fescue, Sandberg bluegrass. Major soil properties that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and moisture are also considerations.

Hardwood trees and the associated woody understory provide cover for wildlife and produce buds, catkins, twigs, bark, or foliage that wildlife eat. Examples of native plants are black cottonwood, aspen, hawthorn, blackberry. Examples of fruit producing shrubs that are commercially available and suitable for planting on soils rated good are Russian-olive, autumn-olive, and crabapple. Major soil properties that affect growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness.

Coniferous plants are cone bearing trees or shrubs that furnish habitat or supply food in the form of browse, seeds, or fruitlike cones. Examples are pine, spruce, hemlock, fir, yew, cedar, and juniper. Major soil properties that affect the growth of coniferous plants are depth of the root zone, available water capacity, and wetness.

Shrubs are bushy woody plants that produce fruits, buds, twigs, bark, or foliage used by wildlife or that provide cover and shade for some species of wildlife. Examples are mountainmahogany, bitterbrush, snowberry, snowbrush, low sagebrush, stiff sagebrush, and buckwheat. Major soil properties that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and moisture.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites, exclusive of submerged or floating aquatics. They produce food or cover for wildlife that use wetland as habitat. Examples of wetland plants are rushes, sedges, saltgrass, and cattail. Major soil properties affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness.

Shallow water areas are bodies of surface water that have an average depth of less than 5 feet and are useful to wildlife. They can be naturally wet areas, or they can be created by dams or levees or by water control devices in marshes or streams. Examples are muskrat marshes, waterfowl feeding areas, wildlife watering developments, beaver ponds, and other wildlife ponds. Major soil properties affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. The availability of a dependable water supply is important if water areas are to be developed.

The kinds of wildlife habitat are briefly described in the following paragraphs.

Openland habitat consists of cropland, pasture, meadow, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The kinds of wildlife attracted to these areas include California quail, pheasants, meadowlark, field sparrow, killdeer, cottontail rabbit, coyote, and woodchuck.

Woodland habitat consists of conifers and associated grasses, legumes, and wild herbaceous plants. Examples of wildlife attracted to this habitat are blue grouse, thrushes, woodpeckers, tree squirrels, raccoon, deer, elk, and black bear.

Wetland habitat consists of water-tolerant plants in open, marshy, or swampy shallow water areas. Examples of wildlife attracted to this habitat are ducks, geese, herons, kingfishers, muskrat, mink, and beaver.

Rangeland habitat consists of wild herbaceous plants and shrubs on range. Examples of wildlife attracted to this habitat are desert mule deer, chukar, and California quail.

Engineering

This section provides information about the use of soils for building sites, sanitary facilities, construction materials, and water management. Among those who can benefit from this section are engineers, landowners, community decision makers and planners, town and city managers, land developers, builders, contractors, and farmers and ranchers.

The ratings in tables in this section are based on test data and estimated data in the "Soil Properties" section. The ratings were determined jointly by soil scientists and engineers of the Soil Conservation Service using known relationships between the soil properties and the behavior of soils in various engineering uses.

Among the soil properties and site conditions identified by the soil survey and used in determining the ratings in this section are grain-size distribution, liquid limit, plasticity index, reaction, depth to and

TABLE 6.—*Wildlife*

[See text for definitions of "good," "fair," "poor," and "very poor."

Soil name and map symbol	Potential for habitat elements				
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants
Alding:					
[1] 1F:					
Alding part	Very poor	Very poor	Fair		Poor
Rock outcrop part					
Lithic Xerochrepts part	Very poor	Poor	Fair		Very poor
Anatone:					
[1] 2D:					
Anatone part	Very poor	Very poor	Poor		
Wrightman part	Poor	Poor	Good		Very poor
Balder:					
3C, 4F	Poor	Fair	Fair		Very poor
Boyce:					
5	Poor	Fair	Fair	Fair	Very poor
Courtrock:					
6B	Fair	Fair	Fair	Very poor	Poor
Daxty:					
7E	Poor	Fair	Good		Fair
[1] 8E:					
Daxty part	Poor	Fair	Good		Fair
Rock outcrop part					
Lithic Xerochrepts part	Very poor	Poor	Fair		Very poor
Dayville:					
9	Good	Good	Poor	Poor	Very poor
Dumps:					
10					
Fopiano:					
11C, 11E	Poor	Fair	Fair		Poor
Grell:					
12E, 13E	Very poor	Very poor	Poor		Very poor
Gwin:					
[1] 14E, [1] 14F:					
Gwin part	Very poor	Very poor	Fair		
Rockly part	Very poor	Very poor	Fair		
[1] 15F:					
Gwin part	Very poor	Very poor	Fair		
Rock outcrop part					
Hack:					
16A, 16B	Good	Good	Good	Good	
16C	Fair	Fair	Good	Very poor	Very poor
17C					
[1] 18D	Very poor	Very poor	Fair		Very poor
Hankins:					
19E, 20E	Poor	Fair	Fair		Good
Helter:					
21C, 21E	Very poor	Poor	Fair		Good
21F	Very poor	Very poor	Fair		Good
Laycock:					
[1] 22E, [1] 23E, [1] 23F:					
Laycock part	Very poor	Very poor	Good		Good
Logdell part	Very poor	Very poor	Poor		Poor

habitat potentials

Absence of an entry indicates the soil was not rated or is not a concern]

Potential for habitat elements			Potential as habitat for—			
Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Fair	Very poor	Very poor		Fair	Very poor	Fair.
Fair	Very poor	Very poor			Very poor	Fair.
Poor	Very poor	Very poor	Very poor		Very poor	Poor.
Good	Very poor	Very poor	Poor		Very poor	Good.
Fair	Very poor	Very poor	Fair		Very poor	Fair.
Poor	Good	Fair	Fair	Fair	Fair	
Fair	Very poor	Very poor	Fair		Very poor	Fair.
Fair	Very poor	Very poor		Fair	Very poor	Fair.
Fair	Very poor	Very poor		Fair	Very poor	Fair.
Fair	Very poor	Very poor			Very poor	Fair.
Fair	Fair	Fair	Fair	Fair	Fair	
Fair	Poor	Very poor	Fair		Very poor	Fair.
Fair	Very poor	Very poor	Very poor		Very poor	Poor.
Poor	Very poor	Very poor	Poor		Very poor	Poor.
Fair	Very poor	Very poor	Very poor		Very poor	Fair.
Poor	Very poor	Very poor	Poor		Very poor	Poor.
Good	Poor	Very poor	Good	Good	Very poor	
Good	Very poor	Very poor	Good		Very poor	Good.
Fair	Very poor	Very poor	Very poor		Very poor	Fair.
Poor	Very poor	Very poor		Good	Very poor	Poor.
Fair	Very poor	Very poor	Poor	Good	Very poor	
Fair	Very poor	Very poor	Very poor	Good	Very poor	
Fair	Very poor	Very poor	Poor	Fair	Very poor	Fair.
Good	Very poor	Very poor	Very poor	Poor	Very poor	Fair.

TABLE 6.—*Wildlife*

Soil name and map symbol	Potential for habitat elements				
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants
Lemonex:					
24E	Poor	Fair	Fair		Fair
[1] 25E:					
Lemonex part	Very poor	Very poor	Fair		Fair
Rock outcrop part					
Lithic Xerochrepts part	Very poor	Poor	Fair		Very poor
Lickskillet:					
[1] 26F	Very poor	Very poor	Fair		
Logdell:					
27F	Very poor	Very poor	Poor		Poor
McGarr:					
28E	Poor	Fair	Fair		Good
[1] 28F	Very poor	Very poor	Fair		Good
[1] 29F:					
McGarr part	Poor	Fair	Fair		Good
Anatone part	Very poor	Very poor	Poor		
Oxbow:					
30B	Fair	Good	Fair		Fair
Oxwall:					
31B	Poor	Fair	Fair		Very poor
32B	Very poor	Very poor	Fair		Very poor
Piersonte:					
[1] 33F:					
Piersonte part	Very poor	Very poor	Fair		Good
Logdell part	Very poor	Very poor	Poor		Poor
Laycock part	Very poor	Very poor	Good		Good
Powder:					
34	Good	Good	Good		Fair
Ricco:					
35	Poor	Fair	Fair	Fair	Very poor
Rock outcrop:					
[1] 36F:					
Rock outcrop part					
Lemonex part	Very poor	Very poor	Fair		Fair
Lithic Xerochrepts part	Very poor	Poor	Fair		Very poor
Rockly:					
37D	Very poor	Very poor	Fair		
Ruddley:					
[1] 38E	Very poor	Very poor	Fair		Fair
Ruddley:					
[1] 39E:					
Ruddley part	Very poor	Very poor	Fair		Fair
Rock outcrop part					
Lithic Xerochrepts part	Very poor	Poor	Fair		Very poor
Simas:					
40E	Poor	Poor	Fair	Very poor	Very poor
41E	Very poor	Very poor	Fair	Very poor	Very poor
[1] 42E:					
Simas part	Very poor	Very poor	Fair	Very poor	Very poor
Day part	Very poor	Poor	Poor		
[1] 43F:					
Simas part	Very poor	Very poor	Fair	Very poor	Very poor
Badland part					

habitat potentials—Continued

Potential for habitat elements			Potential as habitat for—			
Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Fair	Very poor	Very poor	Fair	Fair	Very poor	
Fair	Very poor	Very poor	Poor	Fair	Very poor	
Fair	Very poor	Very poor			Very poor	Fair.
Very poor	Very poor	Very poor	Poor		Very poor	Poor.
Good	Very poor	Very poor	Very poor	Poor	Very poor	Fair.
Good	Very poor	Very poor	Poor	Good	Very poor	Fair.
Good	Very poor	Very poor	Very poor	Good	Very poor	Fair.
Good	Very poor	Very poor	Poor	Good	Very poor	Fair.
Poor	Very poor	Very poor	Very poor		Very poor	Poor.
Poor	Poor	Very poor	Fair	Fair	Very poor	
Poor	Poor	Very poor	Poor		Very poor	Poor.
Poor	Poor	Very poor	Poor		Very poor	Poor.
Fair	Very poor	Very poor	Poor	Fair	Very poor	
Good	Very poor	Very poor	Very poor	Poor	Very poor	Fair.
Fair	Very poor	Very poor	Poor	Fair	Very poor	Fair.
Good	Fair	Fair	Good	Fair	Fair	Good.
Poor	Good	Good	Fair	Fair	Good	
Fair	Very poor	Very poor	Poor	Fair	Very poor	
Fair	Very poor	Very poor			Very poor	Fair.
Fair	Very poor	Very poor	Very poor		Very poor	Fair.
Fair	Very poor	Very poor	Poor	Fair	Very poor	
Fair	Very poor	Very poor	Poor	Fair	Very poor	
Fair	Very poor	Very poor			Very poor	Fair.
Poor	Very poor	Very poor	Poor		Very poor	Poor.
Poor	Very poor	Very poor	Very poor		Very poor	Poor.
Poor	Very poor	Very poor	Very poor		Very poor	Poor.
Very poor	Very poor	Very poor	Very poor		Very poor	Very poor.
Poor	Very poor	Very poor	Very poor		Very poor	Poor.

TABLE 6.—*Wildlife*

Soil name and map symbol	Potential for habitat elements				
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants
Simas: continued					
[1] 44E:					
Simas part	Very poor	Very poor	Fair	Very poor	Very poor
Tub part	Very poor	Very poor	Fair		Poor
Snell:					
45E	Very poor	Poor	Fair		
[1] 46E, [1] 46F:					
Snell part	Very poor	Poor	Fair		
Anatone part	Very poor	Very poor	Poor		
Top:					
47E	Poor	Fair	Good		Good
47F	Very poor	Poor	Good		Good
Tub:					
48E, 48F	Very poor	Very poor	Fair		Poor
49D					
Ukiah:					
50B	Fair	Fair	Fair		Poor
51C, 52E	Very poor	Very poor	Fair		Very poor
Veazie:					
53	Poor	Fair	Fair	Good	Good
Venator:					
54E	Very poor	Very poor	Good		Very poor
[1] 55F:					
Venator part	Very poor	Very poor	Good		Very poor
Rock outcrop part					
Waterbury:					
56E	Very poor	Very poor	Fair		Very poor
Wrightman:					
[1] 57D:					
Wrightman part	Poor	Poor	Good		Very poor
Anatone part	Very poor	Very poor	Poor		

[1] This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and

hardness of bedrock within 5 or 6 feet of the surface, wetness, depth to a seasonal water table, slope, likelihood of flooding, natural soil structure or aggregation, inplace soil density, and geologic origin of the soil material. Where pertinent, data about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of absorbed cations were also considered.

Based on the information assembled about soil properties, ranges of values can be estimated for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, shear strength, compressibility, slope stability, and other factors of expected soil behavior in engineering uses. As appropriate, these values can be applied to each major horizon of each soil or to the entire profile.

These factors of soil behavior affect construction and maintenance of roads, airport runways, pipelines, foundations for small buildings, ponds and small dams, irrigation projects, drainage systems, sewage and refuse disposal systems, and other engineering projects. The ranges of values can be used to select potential residential, commercial, industrial, and recreational areas; make preliminary estimates pertinent to construction in a particular area; evaluate alternate routes for roads, streets, highways, pipelines, and underground cables; evaluate alternate sites for location of sanitary landfills, onsite sewage disposal systems, and other waste disposal facilities; plan detailed onsite investigations of soils and geology; find sources of gravel, sand, clay, and topsoil; plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; relate performance of structures already built to the properties of the kinds of soil on which they are built so that performance of similar structures on the same or a similar soil in other locations can be predicted; and predict the trafficability of soils for cross-country movement of vehicles and construction equipment.

Data presented in this section are useful for land use planning and for choosing alternative practices or general designs that can overcome unfavorable soil properties and minimize soil related failures. Limita-

habitat potentials—Continued

Potential for habitat elements			Potential as habitat for—			
Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Poor Fair	Very poor Very poor	Very poor Very poor	Very poor Poor		Very poor Very poor	Poor. Fair.
Fair	Very poor	Very poor	Very poor		Very poor	Fair.
Fair Poor	Very poor Very poor	Very poor Very poor	Very poor Very poor		Very poor Very poor	Fair. Poor.
Good Good	Very poor Very poor	Very poor Very poor	Fair Poor	Good Good	Very poor Very poor	
Fair	Very poor	Very poor	Poor		Very poor	Fair.
Fair Fair	Very poor Very poor	Very poor Very poor	Fair Very poor	Poor Very poor	Very poor Very poor	Fair. Fair.
Good	Very poor	Very poor	Fair	Good	Very poor	
Good	Very poor	Very poor			Very poor	Good.
Good	Very poor	Very poor			Very poor	Good.
Fair	Very poor	Very poor	Poor		Very poor	Fair.
Good Poor	Very poor Very poor	Very poor Very poor	Poor Very poor		Very poor Very poor	Good. Poor.

behavior of the whole mapping unit.

tions to the use of these data, however, should be understood. First, the data are generally not presented for soil material below a depth of 5 or 6 feet. Also, because of the scale of the detailed map in this soil survey, small areas of soils that differ from the dominant soil are included in mapping. Thus, these data do not eliminate the need for onsite investigations and testing.

The information is presented mainly in tables. Table 7 shows, for each kind of soil, ratings of the degree and kind of limitations for building site development; table 8, for sanitary facilities; and table 10, for water management. Table 9 shows the suitability of each kind of soil as a source of construction materials.

The information in the tables, along with the soil map, the soil descriptions, and other data provided in this survey can be used to make additional interpretations and to construct interpretive maps for specific uses of land.

Some of the terms used in this soil survey have different meanings in soil science and in engineering; the Glossary defines many of these terms.

Building site development

The degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets are indicated in table 7. A *slight* limitation indicates that soil properties are favorable for the specified use; any limitation is minor and easily overcome. A *moderate* limitation indicates that soil properties and site features are unfavorable for the specified use, but the limitations can be overcome or minimized by special planning and design. A *severe* limitation indicates one or more soil properties or site features are so unfavorable or difficult to overcome that a major increase in construction effort, special design, or intensive maintenance is required. For some soils rated severe, such costly measures may not be feasible.

Shallow excavations are used for pipelines, sewerlines, telephone and power transmission lines, base-

TABLE 7.—*Building site development*

["Shrink-swell" and some of the other terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry means soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Alding:					
[1] 1F:					
Alding part	Severe: slope, depth to rock.	Severe: slope, depth to rock, shrink-swell.	Severe: slope, depth to rock, shrink-swell.	Severe: slope, depth to rock.	Severe: slope, depth to rock, shrink-swell.
Rock outcrop part					
Lithic Xerochrepts part	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.
Anatone:					
[1] 2D:					
Anatone part	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock.
Wrightman part	Severe: depth to rock.	Moderate: slope, depth to rock, shrink-swell.	Severe: depth to rock.	Severe: slope	Moderate: slope, depth to rock, shrink-swell.
Balder:					
3C	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.
4F	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.
Boyce:					
5	Severe: wetness, floods.	Severe: floods, wetness, frost action.	Severe: floods, wetness, frost action.	Severe: floods, wetness, frost action.	Severe: floods, wetness, frost action.
Courtrock:					
6B	Slight	Moderate: frost action.	Moderate: frost action.	Moderate: slope, frost action.	Moderate: low strength, frost action.
Daxty:					
7E	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
[1] 8E:					
Daxty part	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Rock outcrop part					
Lithic Xerochrepts part	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.
Dayville:					
9	Severe: wetness, floods.	Severe: floods, wetness, frost action.	Severe: floods, wetness, frost action.	Severe: floods, wetness, frost action.	Severe: frost action, floods.
Dumps:					
10					
Fopiano:					
11C	Severe: depth to rock, too clayey.	Severe: depth to rock, shrink-swell, low strength.	Severe: depth to rock, shrink-swell, low strength.	Severe: depth to rock, slope, shrink-swell.	Severe: depth to rock, low strength, shrink-swell.
11E	Severe: depth to rock, too clayey, slope.	Severe: depth to rock, slope, shrink-swell.	Severe: depth to rock, slope, shrink-swell.	Severe: depth to rock, slope, shrink-swell.	Severe: depth to rock, slope, low strength.

TABLE 7.—*Building site development*—Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Grell: 12E, 13E	Severe: slope, small stones.	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Gwin: [1] 14E, [1] 14F: Gwin part	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.
Rockly part	Severe: depth to rock, slope, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock.
[1] 15F: Gwin part	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock.
Rock outcrop part					
Hack: 16A	Moderate: small stones.	Moderate: frost action.	Moderate: frost action.	Moderate: frost action.	Moderate: frost action, low strength.
16B	Moderate: small stones.	Moderate: frost action.	Moderate: frost action.	Moderate: slope, frost action.	Moderate: frost action, low strength.
16C, 17C	Moderate: slope, small stones.	Moderate: slope, frost action.	Moderate: slope, frost action.	Severe: slope	Moderate: slope, frost action, low strength.
[1] 18D	Severe: large stones.	Severe: large stones.	Severe: large stones.	Severe: large stones, slope.	Moderate: large stones, slope, frost action.
Hankins: 19E, 20E	Severe: too clayey, slope.	Severe: shrink-swell, low strength, slope.	Severe: shrink-swell, low strength, slope.	Severe: shrink-swell, low strength, slope.	Severe: shrink-swell, low strength, slope.
Helter: 21C	Moderate: slope.	Severe: frost action.	Severe: frost action.	Severe: slope, frost action.	Severe: frost action.
21E, 21F	Severe: slope	Severe: slope, frost action.	Severe: slope, frost action.	Severe: slope, frost action.	Severe: slope, frost action.
Laycock: [1] 22E, [1] 23E, [1] 23F: Laycock part	Severe: slope, small stones.	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Logdell part	Severe: slope, small stones.	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Lemonex: 24E	Severe: slope, depth to rock.	Severe: slope, low strength, shrink-swell.	Severe: slope, depth to rock, shrink-swell.	Severe: slope, low strength, shrink-swell.	Severe: slope, low strength, shrink-swell.
[1] 25E: Lemonex part	Severe: slope, depth to rock.	Severe: slope, low strength, shrink-swell.	Severe: slope, depth to rock, low strength.	Severe: slope, shrink-swell, low strength.	Severe: slope, low strength, shrink-swell.
Rock outcrop part					

TABLE 7.—*Building site development*—Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Lemonex: 25E—continued Lithic Xerochrepts part	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope, depth to rock.
Lickskillet: [1] 26F: Lickskillet part	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock.
Rock outcrop part					
Logdell: 27F	Severe: slope, small stones.	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
McGarr: 28E, [1] 28F	Severe: depth to rock, slope.	Severe: slope	Severe: depth to rock, slope.	Severe: slope	Severe: slope, low strength.
[1] 29F: McGarr part	Severe: depth to rock, slope.	Severe: slope	Severe: depth to rock, slope.	Severe: slope	Severe: slope, low strength.
Anatone part	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope. depth to rock.
Oxbow: 30B	Severe: cemented pan, too clayey.	Severe: low strength, shrink-swell.	Severe: shrink-swell, low strength, cemented pan.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
Oxwall: 31B	Severe: cemented pan, too clayey.	Severe: cemented pan, shrink-swell, low strength.	Severe: cemented pan, shrink-swell, low strength.	Severe: cemented pan, shrink-swell, low strength.	Severe: shrink-swell, cemented pan, low strength.
32B	Severe: cemented pan, too clayey, large stones.	Severe: cemented pan, shrink-swell, large stones.	Severe: cemented pan, shrink-swell, large stones.	Severe: cemented pan, shrink-swell, large stones.	Severe: shrink-swell, cemented pan, low strength.
Piersonte: [1] 33F: Piersonte part	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Logdell part	Severe: slope, small stones.	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Laycock part	Severe: slope, small stones.	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Powder: 34	Severe: floods	Severe: floods, frost action.	Severe: floods, frost action.	Severe: floods, frost action.	Severe: frost action.
Ricco: 35	Severe: wetness, floods.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.
Rock outcrop: [1] 36F: Rock outcrop part					
Lemonex part	Severe: slope, depth to rock.	Severe: slope, low strength, shrink-swell.	Severe: slope, depth to rock, shrink-swell.	Severe: slope, shrink-swell, low strength.	Severe: slope, low strength, shrink-swell.

TABLE 7.—*Building site development*—Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Rock outcrop: 36F—continued					
Lithic Xerochrepts part	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.
Rockly: 37D	Severe: depth to rock, large stones, small stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock.
Ruddley: [1] 38E	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope, low strength.
[1] 39E:					
Ruddley part	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope, low strength.
Rock outcrop part					
Lithic Xerochrepts part	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.
Simas: 40E	Severe: slope, too clayey.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell, low strength.
41E	Severe: large stones, slope, too clayey.	Severe: shrink-swell, slope, large stones.	Severe: shrink-swell, slope, large stones.	Severe: shrink-swell, slope, large stones.	Severe: shrink-swell, slope, low strength.
[1] 42E:					
Simas part	Severe: slope, too clayey.	Severe: shrink-swell, slope, large stones.	Severe: shrink-swell, slope, large stones.	Severe: shrink-swell, slope, large stones.	Severe: shrink-swell, slope, low strength.
Day part	Severe: slope, too clayey.	Severe: slope, shrink-swell.	Severe: slope, shrink-swell.	Severe: slope, shrink-swell.	Severe: slope, shrink-swell, low strength.
[1] 43F:					
Simas part	Severe: slope, too clayey.	Severe: shrink-swell, slope, large stones.	Severe: shrink-swell, slope, large stones.	Severe: shrink-swell, slope, large stones.	Severe: shrink-swell, slope, low strength.
Badland part					
[1] 44E:					
Simas part	Severe: slope, too clayey.	Severe: shrink-swell, slope, large stones.	Severe: shrink-swell, slope, large stones.	Severe: shrink-swell, slope, large stones.	Severe: shrink-swell, slope, low strength.
Tub part	Severe: slope	Severe: slope, shrink-swell, large stones.	Severe: slope, shrink-swell, large stones.	Severe: slope, shrink-swell, large stones.	Severe: slope, shrink-swell.
Snell: 45E	Severe: slope, depth to rock.	Severe: slope, shrink-swell, large stones.	Severe: slope, depth to rock, shrink-swell.	Severe: shrink-swell, slope, large stones.	Severe: slope, shrink-swell.
[1] 46E, [1] 46F:					
Snell part	Severe: slope, depth to rock.	Severe: slope, shrink-swell, large stones.	Severe: slope, depth to rock, shrink-swell.	Severe: shrink-swell, slope, large stones.	Severe: slope, shrink-swell.
Anatone part	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock.

TABLE 7.—*Building site development*—Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Top: 47E, 47F	Severe: slope	Severe: slope, shrink-swell.	Severe: slope, shrink-swell.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope, low strength.
Tub: 48E, 48F	Severe: slope	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.
49D	Moderate: slope, small stones, too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: slope, shrink-swell.	Severe: shrink-swell, low strength.
Ukiah: 50B	Severe: depth to rock, too clayey.	Severe: low strength, shrink-swell.	Severe: depth to rock, low strength, shrink-swell.	Severe: depth to rock, low strength, shrink-swell.	Severe: low strength, shrink-swell.
51C	Severe: depth to rock, too clayey.	Severe: low strength, shrink-swell.	Severe: depth to rock, low strength, shrink-swell.	Severe: slope, low strength, shrink-swell.	Severe: low strength, shrink-swell.
52E	Severe: slope, depth to rock, too clayey.	Severe: slope, low strength, shrink-swell.	Severe: depth to rock, slope, low strength.	Severe: slope, low strength, shrink-swell.	Severe: slope, low strength, shrink-swell.
Veazie: 53	Severe: floods	Severe: floods	Severe: floods	Severe: floods	Severe: floods.
Venator: 54E	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.
[1] 55F: Venator part	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.
Rock outcrop part					
Waterbury: 56E	Severe: depth to rock, large stones, slope.	Severe: large stones, shrink-swell, slope.	Severe: depth to rock, shrink-swell, slope.	Severe: depth to rock, shrink-swell, slope.	Severe: depth to rock, shrink-swell, slope.
Wrightman: [1] 57D: Wrightman part	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope	Moderate: slope, depth to rock.
Anatone part	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock.

[1] This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

ments, open ditches, and graves. Such digging or trenching is influenced by wetness caused by a seasonal high water table, the texture and consistence of soils, the tendency of soils to cave in or slough, and the presence of very firm, dense soil layers, bedrock, or large stones. In addition, excavations are affected by slope of the soil and the probability of flooding. Ratings do not apply to soil horizons below a depth of 6 feet unless otherwise noted.

In the soil series descriptions, the consistence of each soil horizon is defined and the presence of very firm or extremely firm horizons, generally difficult to excavate, is indicated.

Dwellings and small commercial buildings referred

to in table 7 are built on undisturbed soil and have foundation loads of a dwelling no more than three stories high. Separate ratings are made for small commercial buildings without basements and for dwellings with and without basements. For such structures, soils should be sufficiently stable that cracking or subsidence from settling or shear failure of the foundation do not occur. These ratings were determined from estimates of the shear strength, compressibility, and shrink-swell potential of the soil. Soil texture, plasticity and in-place density, potential frost action, soil wetness, and depth to a seasonal high water table were also considered. Soil wetness and depth to a seasonal high water table indicate potential difficulty in providing adequate drainage for basements, lawns, and gardens. Depth to bedrock, slope, and the large stones in or on the soil are also important considerations in the choice of sites for these structures and were considered in determining the ratings. Susceptibility to flooding is a serious limitation.

Local roads and streets referred to in table 7 have an all-weather surface that can carry light to medium traffic all year. They consist of subgrade of the underlying soil material; a base of gravel, crushed rock fragments, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. The roads are graded with soil material at hand, and most cuts and fills are less than 6 feet deep.

The load supporting capacity and the stability of the soil as well as the quantity and workability of fill material available are important in design and construction of roads and streets. The AASHTO and Unified classifications of the soil and the soil texture, density, shrink-swell potential, and potential frost action are indicators of the traffic supporting capacity used in making the ratings. Soil wetness, flooding, slope, depth to hard rock or very compact layers, and content of large stones, all of which affect stability and ease of excavation, were also considered.

Sanitary facilities

Favorable soil properties and site features are needed for proper functioning of septic tank absorption fields, sewage lagoons, and sanitary landfills. The nature of the soil is important in selecting sites for these facilities and in identifying limiting soil properties and site features to be considered in design and installation. Also, those soil properties that deal with the ease of excavation or installation of these facilities are of interest to contractors and local officials. Table 8 shows the degree and kind of limitation of each soil for these uses and for use of the soil as daily cover for landfills.

If the degree of soil limitation is indicated by the rating *slight,* soils are favorable for the specified use and limitations are minor and easily overcome; if *moderate,* soil properties or site features are unfavorable for the specified use, but limitations can be overcome by special planning and design; and if *severe,* soil properties or site features are so unfavorable or difficult to overcome that major soil reclamation, special designs, or intensive maintenance are required.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into the natural soil. Only the soil horizons between depths of 18 and 72 inches are evaluated for this use. The soil properties and site features considered are those that affect the absorption of the effluent and those that affect the construction of the system.

Properties and features that affect the absorption of the effluent are permeability, depth to seasonal high water table, depth to bedrock, and susceptibility to flooding. Stones, boulders, and a shallow depth to bedrock interfere with installation. Excessive slope can cause lateral seepage and surfacing of the effluent in downslope areas. Also, soil erosion and soil slippage are hazards where absorption fields are installed in sloping soils.

Some soils are underlain by loose sand and gravel or fractured bedrock at a depth less than 4 feet below the tile lines. In these soils the absorption field does not adequately filter the effluent, and as a result ground water supplies in the area may be contaminated.

Percolation tests are performed to determine the absorptive capacity of the soil and its suitability for septic tank absorption fields. These tests should be performed during the season when the water table is higher and the soil is at minimum absorptive capacity.

In many of the soils that have moderate or severe limitations for septic tank absorption fields, it is possible to install special systems that lower the seasonal water table or to increase the size of the absorption field so that satisfactory performance is achieved.

Sewage lagoons are shallow ponds constructed to hold sewage while bacteria decompose the solid and liquid wastes. Lagoons have a nearly level flow area surrounded by cut slopes or embankments of compacted, nearly impervious soil material. They generally are designed so that depth of the sewage is 2 to 5 feet. Impervious soil material at least 4 feet thick is required for the lagoon floor and sides to minimize seepage and contamination of local ground water. Soils that are very high in content of organic matter and those that have stones and boulders are undesirable. Unless the soil has very slow permeability, contamination of local ground water is a hazard in areas where the seasonal high water table is above the level of the lagoon floor. In soils where the water table is seasonally high, seepage of ground water into the lagoon can seriously reduce its capacity for liquid waste. Slope, depth to bedrock, and susceptibility to flooding also affect the location of sites for sewage lagoons or the cost of construction. Shear strength and permeability of compacted soils affect the performance of embankments.

Sanitary landfill is soil waste (refuse) and soil material that is placed in successive layers either in excavated trenches or on the surface of the soil. The waste is spread, compacted in layers, and covered with thin layers of soil material. Landfill areas are subject to heavy vehicular traffic. Ease of excavation, risk of polluting ground water, and trafficability affect the suitability of a soil for this purpose. The best soils are loamy or silty, have moderate or slow permeability, are deep to bedrock and a seasonal water table, are free of large stones and boulders, and are not subject to flooding. In areas where the seasonal water table is high, water seeps into the trenches and causes con-

TABLE 8.—*Sanitary facilities*

["Area reclaim" and some of the other terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "severe" and other terms used to rate soils. Absence of an entry means soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoons	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Alding:					
[1]1F:					
Alding part	Severe: slope, depth to rock, percs slowly.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope	Poor: slope, thin layer, area reclaim.
Rock outcrop part					
Lithic Xerochrepts part	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope	Poor: slope, thin layer, area reclaim.
Anatone:					
[1]2D:					
Anatone part	Severe: depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, large stones.	Moderate: slope.	Poor: thin layer, small stones, large stones.
Wrightman part	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Moderate: slope.	Fair: slope, thin layer, area reclaim.
Balder:					
3C	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Moderate: slope.	Poor: thin layer, area reclaim.
4F	Severe: slope, depth to rock.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock.	Severe: slope	Poor: slope, thin layer, area reclaim.
Boyce:					
5	Severe: floods, wetness.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Poor: wetness.
Courtrock:					
6B	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
Daxty:					
7E	Severe: slope, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope, depth to rock.	Severe: slope	Poor: small stones, slope.
[1]8E:					
Daxty part	Severe: slope, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: depth to rock.	Severe: slope	Poor: small stones, slope.
Rock outcrop part					
Lithic Xerochrepts part	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope	Poor: slope, thin layer, area reclaim.
Dayville:					
9	Severe: floods, wetness.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Good.
Dumps:					
10					

TABLE 8.—*Sanitary facilities*—Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoons	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Fopiano:					
11C	Severe: percs slowly, depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Moderate: slope.	Poor: thin layer, too clayey.
11E	Severe: percs slowly, depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope	Poor: thin layer, too clayey, slope.
Grell:					
12E	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: slope	Poor: slope, thin layer, small stones.
13E	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope	Poor: slope, thin layer, small stones.
Gwin:					
[1] 14E:					
Gwin part	Severe: slope, depth to rock, percs slowly.	Severe: depth to rock, large stones, small stones.	Severe: depth to rock.	Severe: slope	Poor: thin layer, small stones.
Rockly part	Severe: slope, depth to rock, percs slowly.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: slope	Poor: slope, thin layer, large stones.
[1] 14F:					
Gwin part	Severe: slope, depth to rock, percs slowly.	Severe: depth to rock, large stones, small stones.	Severe: slope, depth to rock.	Severe: slope	Poor: thin layer, small stones, slope.
Rockly part	Severe: slope, depth to rock, percs slowly.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope	Poor: slope, thin layer, large stones.
[1] 15F:					
Gwin part	Severe: depth to rock, slope, percs slowly.	Severe: depth to rock, large stones, small stones.	Severe: slope, depth to rock, large stones.	Severe: slope	Poor: slope, thin layer, large stones.
Rock outcrop part					
Hack:					
16A	Severe: percs slowly.	Slight	Slight	Slight	Good.
16B	Severe: percs slowly.	Moderate: slope.	Slight	Slight	Good.
16C, 17C	Severe: percs slowly.	Severe: slope	Slight	Moderate: slope.	Fair: slope.
[1] 18D	Severe: large stones, percs slowly.	Severe: slope, large stones.	Severe: large stones.	Moderate: slope.	Poor: large stones.
Hankins:					
19E	Severe: percs slowly, slope.	Severe: slope	Severe: too clayey, slope.	Severe: slope	Poor: too clayey, slope.
20E	Severe: percs slowly, slope.	Severe: slope	Severe: too clayey.	Severe: slope	Poor: too clayey, slope.
Helter:					
21C	Severe: percs slowly.	Severe: slope	Slight	Moderate: slope.	Fair: slope.

TABLE 8.—*Sanitary facilities*—Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoons	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Helter—continued:					
21E, 21F	Severe: percs slowly, slope.	Severe: slope	Severe: slope	Severe: slope	Poor: slope.
Laycock:					
[1] 22E, [1] 23E, [1] 23F:					
Laycock part	Severe: slope	Severe: slope, seepage, small stones.	Severe: slope, seepage, small stones.	Severe: slope, seepage.	Poor: slope, small stones, seepage.
Logdell part	Severe: slope	Severe: slope, seepage, small stones.	Severe: slope, seepage, small stones.	Severe: slope, seepage.	Poor: slope, small stones, seepage.
Lemonex:					
24E	Severe: slope, depth to rock. percs slowly.	Severe: slope, depth to rock.	Severe: slope, depth to rock, too clayey.	Severe: slope	Poor: slope, too clayey, area reclaim.
[1] 25E:					
Lemonex part	Severe: slope, depth to rock. percs slowly.	Severe: slope, depth to rock.	Severe: depth to rock, too clayey.	Severe: slope	Poor: slope, too clayey, area reclaim.
Rock outcrop part					
Lithic Xerochrepts part	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope	Poor: slope, thin layer, area reclaim.
Lickskillet:					
[1] 26F:					
Lickskillet part	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope	Poor: slope, large stones, thin layer.
Rock outcrop part					
Logdell:					
27F	Severe: slope	Severe: slope, seepage, small stones.	Severe: slope, seepage, small stones.	Severe: slope, seepage.	Poor: slope, small stones, seepage.
McGarr:					
28E, [1] 28F	Severe: depth to rock, slope, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope	Poor: thin layer, area reclaim, slope.
[1] 29F:					
McGarr part	Severe: depth to rock, slope, percs slowly.	Severe: depth to rock, large stones, slope.	Severe: depth to rock, slope.	Severe: slope	Poor: thin layer, area reclaim, slope.
Anatone part	Severe: slope, depth to rock. large stones.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope	Poor: slope, thin layer, large stones.
Oxbow:					
30B	Severe: cemented pan, percs slowly.	Severe: cemented pan.	Severe: cemented pan, too clayey.	Slight	Poor: too clayey.
Oxwall:					
31B	Severe: cemented pan, percs slowly.	Severe: cemented pan, large stones.	Severe: cemented pan, too clayey.	Slight	Poor: thin layer, too clayey.
32B	Severe: cemented pan, percs slowly, large stones.	Severe: cemented pan, large stones.	Severe: cemented pan, too clayey, large stones.	Slight	Poor: thin layer, too clayey, large stones.

TABLE 8.—*Sanitary facilities*—Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoons	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Piersonte:					
[1] 33F:					
Piersonte part	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Poor: slope.
Logdell part	Severe: slope	Severe: slope, seepage, small stones.	Severe: slope, seepage, small stones.	Severe: slope, seepage.	Poor: slope, small stones, seepage.
Laycock part	Severe: slope	Severe: slope, seepage, small stones.	Severe: slope, seepage, small stones.	Severe: slope, seepage.	Poor: slope, small stones, seepage.
Powder:					
34	Severe: floods	Severe: floods	Severe: floods	Severe: floods	Good.
Ricco:					
35	Severe: wetness, floods, percs slowly.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
Rock outcrop:					
[1] 36F:					
Rock outcrop part					
Lemonex part	Severe: slope, depth to rock, percs slowly.	Severe: slope, depth to rock.	Severe: slope, depth to rock, too clayey.	Severe: slope	Poor: slope, too clayey, area reclaim.
Lithic Xerochrepts part	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope	Poor: slope, thin layer, area reclaim.
Rockly:					
37D	Severe: depth to rock, percs slowly, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, large stones.	Moderate: slope.	Poor: thin layer, large stones, small stones.
Ruddley:					
[1] 38E	Severe: slope, depth to rock, percs slowly.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: slope	Poor: slope, thin layer, area reclaim.
[1] 39E:					
Ruddley part	Severe: slope, depth to rock, percs slowly.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: slope	Poor: slope, thin layer, area reclaim.
Rock outcrop part					
Lithic Xerochrepts part	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope	Poor: slope, thin layer, area reclaim.
Simas:					
40E	Severe: slope, percs slowly.	Severe: slope	Severe: too clayey.	Severe: slope	Poor: too clayey, slope.
41E	Severe: percs slowly, slope.	Severe: slope, large stones.	Severe: too clayey, small stones.	Severe: slope	Poor: slope, too clayey.
[1] 42E:					
Simas part	Severe: percs slowly, slope.	Severe: slope, large stones.	Severe: too clayey, small stones.	Severe: slope	Poor: slope, too clayey.

TABLE 8.—*Sanitary facilities*—Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoons	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Simas: 42E—continued					
Day part	Severe: slope, percs slowly.	Severe: slope	Severe: too clayey.	Severe: slope	Poor: slope, too clayey.
[1] 43F:					
Simas part	Severe: percs slowly, slope.	Severe: slope, large stones.	Severe: too clayey, small stones, slope.	Severe: slope	Poor: slope, too clayey.
Badland part					
[1] 44E:					
Simas part	Severe: percs slowly, slope.	Severe: slope, large stones.	Severe: too clayey, small stones.	Severe: slope	Poor: slope, too clayey.
Tub part	Severe: slope, percs slowly.	Severe: slope, large stones.	Moderate: slope, too clayey.	Severe: slope	Poor: slope.
Snell:					
45E	Severe: slope, depth to rock, percs slowly.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock.	Severe: slope	Poor: slope, small stones, thin layer.
[1] 46E, [1] 46F:					
Snell part	Severe: slope, depth to rock, percs slowly.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock.	Severe: slope	Poor: slope, small stones, thin layer.
Anatone part	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope	Poor: slope, thin layer, large stones.
Top:					
47E, 47F	Severe: slope, percs slowly, depth to rock.	Severe: slope	Severe: slope, depth to rock.	Severe: slope	Poor: slope.
Tub:					
48E, 48F	Severe: slope, percs slowly.	Severe: slope	Severe: slope	Severe: slope	Poor: slope.
49D	Severe: percs slowly.	Severe: slope	Moderate: too clayey.	Moderate: slope.	Fair: slope, thin layer, too clayey.
Ukiah:					
50B	Severe: percs slowly, depth to rock.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Slight	Poor: too clayey, small stones.
51C	Severe: percs slowly, depth to rock.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, too clayey.	Moderate: slope.	Poor: too clayey, small stones.
52E	Severe: slope, depth to rock, percs slowly.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, too clayey.	Severe: slope	Poor: slope, too clayey, large stones.
Veazie:					
53	Severe: floods	Severe: floods, seepage.	Severe: floods, seepage.	Severe: floods, seepage.	Fair: small stones.
Venator:					
54E	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: slope	Poor: slope, thin layer, area reclaim.
[1] 55F:					
Venator part	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope	Poor: slope, thin layer, area reclaim.

TABLE 8.—*Sanitary facilities*—Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoons	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Venator: 55F—continued					
Rock outcrop part					
Waterbury:					
56E	Severe: depth to rock, slope, percs slowly.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, large stones, too clayey.	Severe: slope	Poor: thin layer, large stones, slope.
Wrightman:					
[1] 57D:					
Wrightman part	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Moderate: slope.	Fair: slope, thin layer.
Anatone part	Severe: depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, large stones.	Moderate: slope.	Poor: thin layer, small stones, large stones.

[1] This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

cern in excavating and filling the trenches. Also, seepage into the refuse increases the risk of pollution of ground water. Clayey soils are likely to be sticky and difficult to spread. Sandy or gravelly soils generally have rapid permeability that might allow noxious liquids to contaminate local ground water.

Unless otherwise stated, the ratings in table 8 apply only to soil properties and features within a depth of about 6 feet. If the trench is deeper, ratings of slight or moderate may not be valid. Site investigation is needed before a site is selected.

In the area type of sanitary landfill, refuse is placed on the surface of the soil in successive layers. The limitations caused by soil texture, depth to bedrock, and stone content do not apply to this type of landfill. Soil wetness, however, can be a limitation because of difficulty in operating equipment.

Daily cover for sanitary landfills should be soil that is easy to excavate and spread over the compacted fill during both wet and dry weather. Soils that are loamy or silty and free of stones or boulders are better than other soils. Clayey soils can be sticky and difficult to spread; sandy soils can be subject to soil blowing.

In addition to these features, the soils selected for final cover of landfills should be suitable for growing plants. In comparison with other horizons, the A horizon in most soils has the best workability, more content of organic matter, and the best potential for growing plants. Thus, for either the area or trench type landfill, stockpiling material from the A horizon for use as the surface layer of the final cover is desirable.

Where it is necessary to bring in soil material for daily or final cover, thickness of suitable soil material available and depth to a seasonal high water table in soils surrounding the sites should be evaluated. Other factors to be evaluated are those that affect reclamation of the borrow areas, such as slope, erodibility, and potential for plant growth.

Construction materials

The suitability of each soil as a source of roadfill, sand, gravel, and topsoil is indicated in table 9 by ratings of good, fair, or poor. The texture, thickness, and content of organic matter of each soil horizon are important factors in rating soils for use as construction materials. Each soil is evaluated to the depth observed and described as the survey is made, generally about 6 feet.

Roadfill is soil material used in embankments for roads. The ratings reflect the ease of excavating and working the material and the expected performance of the material after it has been compacted and adequately drained. The performance of soil after it is stabilized with lime or cement is not considered in the ratings, but information about soil properties that determine such performance is given in the descriptions of soil series.

The ratings apply to the soil profile between the A horizon and a depth of 5 to 6 feet. It is assumed that soil horizons are mixed during excavation and spreading. Many soils have horizons of contrasting suitability within the profile. The estimated engineering properties in table 12 provide more specific information about the nature of each horizon that can help determine its suitability for roadfill.

According to the Unified soil classification system, soils rated *good* have low shrink-swell potential, low potential frost action, and few cobbles and stones. They are at least moderately well drained and have slopes of 15 percent or less. Soils rated *fair* have a plasticity index of less than 15 and have other limiting features, such as high shrink-swell potential, high potential frost action, steep slopes, wetness, or many stones. If the thickness of suitable material is less than 3 feet, the entire soil is rated *poor*, regardless of the quality of the suitable material.

Sand and gravel are used in great quantities in many

TABLE 9.—*Construction materials*

["Shrink-swell" and some of the other terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and "poor." Absence of an entry means soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Alding:				
[1] 1F:				
Alding part	Poor: slope, thin layer, area reclaim.	Unsuited	Unsuited	Poor: slope, small stones, area reclaim.
Rock outcrop part				
Lithic Xerochrepts part	Poor: thin layer, area reclaim, slope.	Unsuited	Unsuited	Poor: thin layer, area reclaim, slope.
Anatone:				
[1] 2D:				
Anatone part	Poor: thin layer, area reclaim.	Unsuited	Unsuited: thin layer.	Poor: small stones, large stones, area reclaim.
Wrightman part	Poor: thin layer, area reclaim.	Unsuited	Unsuited	Fair: slope.
Balder:				
3C	Poor: area reclaim, thin layer.	Unsuited	Unsuited	Poor: area reclaim.
4F	Poor: slope, area reclaim, thin layer.	Unsuited	Unsuited	Poor: large stones, area reclaim, slope.
Boyce:				
5	Poor: wetness, frost action.	Good	Good	Poor: wetness.
Courtrock:				
6B	Good	Fair: excess fines	Fair: excess fines	Good.
Daxty:				
7E	Poor: slope, thin layer, area reclaim.	Unsuited	Unsuited	Poor: slope, small stones.
[1] 8E:				
Daxty part	Poor: slope, thin layer, area reclaim.	Unsuited	Unsuited	Poor: slope, small stones.
Rock outcrop part				
Lithic Xerochrepts part	Poor: slope, thin layer.			Poor: slope.
Dayville:				
9	Poor: frost action	Good	Good	Good.
Dumps:				
10				
Fopiano:				
11C	Poor: thin layer, low strength, shrink-swell.	Unsuited	Unsuited	Poor: thin layer, too clayey, area reclaim.
11E	Poor: thin layer, slope, low strength.	Unsuited	Unsuited	Poor: slope, too clayey, thin layer.
Grell:				
12E	Poor: thin layer, area reclaim.	Unsuited	Unsuited: thin layer.	Poor: slope, small stones, area reclaim.
13E	Poor: slope, thin layer, area reclaim.	Unsuited	Unsuited: thin layer.	Poor: slope, small stones, area reclaim.

TABLE 9.—*Construction materials*—Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Gwin:				
[1] 14E:				
Gwin part	Poor: thin layer, area reclaim.	Unsuited	Unsuited: thin layer.	Poor: slope, large stones, small stones.
Rockly part	Poor: thin layer, large stones, area reclaim.	Unsuited	Unsuited: thin layer.	Poor: large stones, small stones, slope.
[1] 14F:				
Gwin part	Poor: thin layer, area reclaim, slope.	Unsuited	Unsuited: thin layer.	Poor: slope, large stones, small stones.
Rockly part	Poor: slope, thin layer, large stones.	Unsuited	Unsuited: thin layer.	Poor: large stones, small stones, slope.
[1] 15F:				
Gwin part	Poor: thin layer, area reclaim, slope.	Unsuited	Unsuited: thin layer.	Poor: slope, large stones, small stones.
Rock outcrop part				
Hack:				
16A, 16B	Fair: low strength, frost action.	Unsuited	Unsuited	Good.
16C	Fair: low strength, frost action.	Unsuited	Unsuited	Fair: slope.
17C	Fair: low strength, frost action.	Unsuited	Unsuited	Poor: small stones.
[1] 18D	Fair: large stones, frost action, low strength.	Unsuited	Unsuited	Poor: large stones, small stones.
Hankins:				
19E	Poor: low strength, shrink-swell, slope.	Unsuited	Unsuited	Poor: slope.
20E	Poor: low strength, shrink-swell.	Unsuited	Unsuited	Poor: slope.
Helter:				
21C	Poor: frost action	Unsuited	Unsuited	Fair: slope.
21E, 21F	Poor: slope, frost action.	Unsuited	Unsuited	Poor: slope.
Laycock:				
[1] 22E, [1] 23E, [1] 23F:				
Laycock part	Poor: slope, area reclaim.	Unsuited	Unsuited	Poor: slope, small stones, area reclaim.
Logdell part	Poor: slope, area reclaim.	Unsuited	Unsuited	Poor: small stones, slope, area reclaim.
Lemonex:				
24E	Poor: slope, low strength, shrink-swell.	Unsuited	Unsuited	Poor: slope, large stones, area reclaim.

TABLE 9.—*Construction materials*—Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Lemonex—continued:				
[1] 25E:				
Lemonex part	Poor: low strength, shrink-swell, area reclaim.	Unsuited	Unsuited	Poor: slope, large stones, area reclaim.
Rock outcrop part				
Lithic Xerochrepts part	Poor: thin layer, slope, area reclaim.	Unsuited	Unsuited	Poor: thin layer, area reclaim, slope.
Lickskillet:				
[1] 26F:				
Lickskillet part	Poor: slope, large stones, thin layer.	Unsuited	Unsuited	Poor: slope, large stones, small stones.
Rock outcrop part				
Logdell:				
27F	Poor: slope, area reclaim.	Unsuited	Unsuited	Poor: small stones, slope, area reclaim.
McGarr:				
28E, [1] 28F	Poor: thin layer, low strength, slope.	Unsuited	Unsuited	Poor: large stones, slope, area reclaim.
[1] 29F:				
McGarr part	Poor: slope, thin layer, low strength.	Unsuited	Unsuited	Poor: large stones, slope, area reclaim.
Anatone part	Poor: slope, thin layer.	Unsuited	Unsuited	Poor: slope, small stones, large stones.
Oxbow:				
30B	Poor: shrink-swell, thin layer, low strength.	Unsuited	Unsuited	Poor: large stones.
Oxwall:				
31B, 32B	Poor: thin layer, shrink-swell, low strength.	Unsuited	Unsuited	Poor: large stones, area reclaim.
Piersonte:				
[1] 33F:				
Piersonte part	Poor: slope	Unsuited	Unsuited	Poor: slope, small stones.
Logdell part	Poor: slope, area reclaim.	Unsuited	Unsuited	Poor: small stones, slope, area reclaim.
Laycock part	Poor: slope, area reclaim.	Unsuited	Unsuited	Poor: slope, small stones, area reclaim.
Powder:				
34	Poor: frost action	Unsuited	Unsuited	Good.
Ricco:				
35	Poor: wetness, low strength, frost action.	Unsuited	Unsuited	Poor: wetness.
Rock outcrop:				
[1] 36F:				
Rock outcrop part				
Lemonex part	Poor: slope, low strength, shrink-swell.	Unsuited	Unsuited	Poor: slope, low strength, too clayey.
Lithic Xerochrepts part	Poor: thin layer, slope, area reclaim.	Unsuited	Unsuited	Poor: thin layer, slope, area reclaim.

TABLE 9.—*Construction materials*—Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Rockly:				
37D	Poor: thin layer, large stones, area reclaim.	Unsuited	Unsuited: thin layer.	Poor: large stones, small stones, thin layer.
Ruddley:				
[1] 38E	Poor: thin layer, low strength, area reclaim.	Unsuited	Unsuited	Poor: slope, area reclaim.
[1] 39E:				
Ruddley part	Poor: thin layer, low strength, area reclaim.	Unsuited	Unsuited	Poor: slope, area reclaim.
Rock outcrop part				
Lithic Xerochrepts part	Poor: thin layer, slope, area reclaim.	Unsuited	Unsuited	Poor: thin layer, slope, area reclaim.
Simas:				
40E	Poor: shrink-swell, low strength.	Unsuited	Unsuited	Poor: too clayey, small stones, slope.
41E	Poor: shrink-swell, low strength.	Unsuited	Unsuited	Poor: too clayey, large stones, slope.
[1] 42E:				
Simas part	Poor: shrink-swell, low strength.	Unsuited	Unsuited	Poor: too clayey, large stones, slope.
Day part	Poor: shrink-swell, low strength.	Unsuited	Unsuited	Poor: slope, too clayey.
[1] 43F:				
Simas part	Poor: shrink-swell, slope, low strength.	Unsuited	Unsuited	Poor: too clayey, large stones, slope.
Badland part				
[1] 44E:				
Simas part	Poor: shrink-swell, low strength.	Unsuited	Unsuited	Poor: too clayey, large stones, slope.
Tub part	Poor: shrink-swell, low strength.	Unsuited	Unsuited	Poor: slope, large stones, too clayey.
Snell:				
45E	Poor: slope, thin layer, shrink-swell.	Unsuited	Unsuited	Poor: small stones, large stones, slope.
[1] 46E, [1] 46F:				
Snell part	Poor: slope, thin layer, shrink-swell.	Unsuited	Unsuited	Poor: large stones, slope.
Anatone part	Poor: slope, thin layer, area reclaim.	Unsuited	Unsuited	Poor: slope, small stones, large stones.
Top:				
47E, 47F	Poor: shrink-swell, slope, low strength.	Unsuited	Unsuited	Poor: slope, too clayey.
Tub:				
48E, 48F	Poor: slope, shrink-swell, low strength.	Unsuited	Unsuited: excess fines.	Poor: slope, small stones, too clayey.
49D	Poor: shrink-swell, low strength.	Unsuited	Unsuited: excess fines.	Poor: small stones, too clayey.
Ukiah:				
50B	Poor: low strength, shrink-swell, thin layer.	Unsuited	Unsuited	Poor: small stones, too clayey.

TABLE 9.—*Construction materials*—Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ukiah—continued:				
51C	Poor: low strength, shrink-swell, thin layer.	Unsuited	Unsuited	Poor: large stones, too clayey.
52E	Poor: slope, shrink-swell, thin layer.	Unsuited	Unsuited	Poor: slope, large stones, too clayey.
Veazie:				
53	Good	Fair: excess fines	Fair: excess fines	Good.
Venator:				
54E	Poor: thin layer, area reclaim.	Unsuited	Unsuited: thin layer.	Poor: slope, small stones, area reclaim.
[1] 55F:				
Venator part	Poor: slope, thin layer, area reclaim.	Unsuited	Unsuited: thin layer.	Poor: slope, small stones, area reclaim.
Rock outcrop part				
Waterbury:				
56E	Poor: thin layer, low strength, shrink-swell.	Unsuited	Unsuited	Poor: slope, large stones, too clayey.
Wrightman:				
[1] 57D:				
Wrightman part	Fair: thin layer, low strength, frost action.	Unsuited	Unsuited	Fair: slope.
Anatone part	Poor: thin layer, area reclaim.	Unsuited	Unsuited	Poor: small stones, large stones, area reclaim.

[1] This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

kinds of construction. The ratings in table 9 provide guidance as to where to look for probable sources and are based on the probability that soils in a given area contain sizable quantities of sand or gravel. A soil rated *good* or *fair* has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 6 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel. Fine grained soils are not suitable sources of sand and gravel.

The ratings do not take into account depth to the water table or other factors that affect excavation of the material. Descriptions of grain size, kinds of minerals, reaction, and stratification are given in the soil series descriptions and in table 12.

Topsoil is used in areas where vegetation is to be established and maintained. Suitability is affected mainly by the ease of working and spreading the soil material in preparing a seedbed and by the ability of the soil material to sustain the growth of plants. Also considered is the damage that would result to the area from which the topsoil is taken.

Soils rated *good* have at least 16 inches of friable loamy material at their surface. They are free of stones, are low in content of gravel and other coarse fragments, are gently sloping, and are low in soluble salts, which can limit plant growth. Soils so rated are naturally fertile or respond well to fertilization. They are not so wet that excavation is difficult during most of the year.

Soils rated *fair* are loose sandy soils or are firm loamy or clayey soils in which the suitable material is only 8 to 16 inches thick or soils that have appreciable amounts of gravel, stones, or soluble salt.

Soils rated *poor* are steep soils, poorly drained soils, very sandy soils, very firm clayey soils, soils that have suitable layers less than 8 inches thick, or soils that have large amounts of gravel, stones, or soluble salts.

Although a rating of *good* is not based entirely on high content of organic matter a surface horizon is much preferred for topsoil because of its content of organic matter. This horizon is designated as A1 or Ap in the soil series descriptions. The absorption and retention of moisture and nutrients for plant growth are greatly increased by organic matter. Consequently, careful preservation and use of material from these horizons is desirable.

Water management

Many soil properties and site features that affect water management practices have been identified in this soil survey. In table 10 the degree of soil limitation

and soil and site features that affect use are indicated for each kind of soil. This information is significant in planning, installing, and maintaining water control structures.

Soil and site limitation are expressed as slight, moderate, and severe. *Slight* means that the soil properties and site features are generally favorable for the specified use and that any limitation is minor and easily overcome. *Moderate* means that some soil properties or site features are unfavorable for the rated use but can be overcome or modified by special planning and design. *Severe* means that the soil properties and site features are so unfavorable and so difficult to correct or overcome that major soil reclamation, special design, or intensive maintenance is required.

Pond reservoir areas hold water behind a dam or embankment. Soils suitable for this use have low seepage potential, which is determined by the permeability and depth over fractured or permeable bedrock or other permeable material.

Embankments, dikes, and levees require soil material that is resistant to seepage, erosion, and piping and is of favorable stability, shrink-swell potential, shear strength, and compaction characteristics. Stones and organic matter in a soil downgrade the suitability of a soil for use in embankments, dikes, and levees.

Drainage of soil is affected by such soil properties as permeability, texture, structure, depth to claypan or other layers that influence rate of water movement, depth to the water table, slope, stability of ditchbanks, susceptibility to flooding, salinity and alkalinity, and availability of outlets for drainage.

Irrigation is affected by such features as slope, susceptibility to flooding, hazards of water erosion and soil blowing, texture, presence of salts and alkali, depth of root zone, rate of water intake at the surface, permeability of the soil below the surface layer, available water capacity, need for drainage, and depth to the water table.

Terraces and diversions are embankments, or a combination of channels and ridges, constructed across a slope to intercept runoff and allow the water to soak into the soil or flow slowly to an outlet. Features that affect suitability of a soil for terraces are uniformity of slope and steepness, depth to bedrock or other unfavorable material, permeability, ease of establishing vegetation, and resistance to water erosion, to soil blowing, to soil slipping, and to piping.

Grassed waterways are constructed to channel runoff at nonerosive velocities to outlets. Features that affect the use of soils for waterways are slope, permeability, erodibility, and suitability for permanent vegetation.

Recreation

The soils of the survey area are rated in table 11 according to limitations that affect their suitability for camp areas, picnic areas, playgrounds, and paths and trails. The ratings are based on such restrictive soil features as flooding, wetness, slope, and texture of the surface layer. Not considered in these ratings, but important in evaluating a site, are location and accessibility of the area, size and shape of the area and its scenic quality, the ability of the soil to support vegetation, access to water, potential water impoundment sites available, and either access to public sewerlines or capacity of the soil to absorb septic tank effluent. Soils subject to flooding are limited, in varying degree, for recreation use by the duration of flooding and the season when it occurs. Onsite assessment of height, duration, and frequency of flooding is essential in planning recreation facilities.

In table 11 the limitations of soils are rated as slight, moderate, or severe. *Slight* means that the soil properties are generally favorable and that the limitations are minor and easily overcome. *Moderate* means that the limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 11 can be supplemented by additional information in other parts of this survey. Especially helpful are interpretations for septic tank absorption fields given in table 8 and interpretations for dwellings without basements and for local roads, and streets given in table 7.

Camp areas require such site preparation as shaping and leveling tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils for this use have mild slopes and are not wet nor subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing camping sites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for use as picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and not wet nor subject to flooding during the season of use. The surface is free of stones or boulders, is firm after rain, and is not dusty when dry. If shaping is required to obtain a uniform grade, the depth of the soil over rock should be sufficient to allow necessary grading.

The design and layout of *paths and trails* for walking, horseback riding, and bicycling should require little or no cutting and filling. The best soils for this use are those that are not wet, are firm after rain, are not dusty when dry, and are not subject to flooding more than once during the period of use. They should have moderate slopes and have few or no stones or boulders on the surface.

Soil properties

Extensive data about soil properties collected during the soil survey are summarized on the following pages. The two main sources of these data are the many thousands of soil borings made during the course of the survey and the laboratory analyses of samples selected from representative soil profiles in the field.

TABLE 10.—*Water*

["Seepage," and some of the other terms that describe restrictive soil features

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees
Alding:		
[1] 1F:		
Alding part	Slope, depth to rock	Thin layer, shrink-swell, low strength
Rock outcrop part		
Lithic Xerochrepts part	Depth to rock, slope	Thin layer
Anatone:		
[1] 2D:		
Anatone part	Slope, depth to rock	Thin layer, large stones
Wrightman part	Depth to rock, slope	Thin layer, piping
Balder:		
3C, 4F	Slope, depth to rock	Depth to rock, piping
Boyce:		
5	Seepage	Seepage, piping
Courtrock:		
6B	Seepage	Piping
Daxty:		
7E	Seepage, slope, depth to rock	Piping, thin layer
[1] 8E:		
Daxty part	Seepage, slope, depth to rock	Piping, thin layer
Rock outcrop part		
Lithic Xerochrepts part	Depth to rock, slope	Thin layer
Dayville:		
9	Seepage	Hard to pack, piping, seepage
Dumps:		
10		
Fopiano:		
11C	Slope, depth to rock	Thin layer, low strength
11E	Slope, depth to rock	Thin layer, low strength
Grell:		
12E, 13E	Slope, depth to rock	Thin layer, piping
Gwin:		
[1] 14E, [1] 14F:		
Gwin part	Slope, depth to rock	Thin layer, large stones
Rockly part	Depth to rock, slope	Thin layer, large stones
[1] 15F:		
Gwin part	Slope, depth to rock	Thin layer, large stones
Rock outcrop part		
Hack:		
16A, 16B	Favorable	Piping

management

are defined in the Glossary. Absence of an entry means soil was not evaluated]

Drainage	Irrigation	Terraces and diversions	Grassed waterways
Depth to rock, percs slowly, slope.	Percs slowly, rooting depth, slope.	Slope, depth to rock, percs slowly.	Slope, rooting depth.
Depth to rock, slope	Rooting depth, slope	Slope, depth to rock	Slope, rooting depth.
Depth to rock, slope	Rooting depth, slope, large stones.	Slope, depth to rock, large stones.	Rooting depth, slope, large stones.
Depth to rock, slope	Rooting depth, slope	Depth to rock, rooting depth, piping.	Slope, rooting depth.
Depth to rock, slope	Rooting depth, slope	Depth to rock, slope, large stones.	Depth to rock, slope.
Floods, wetness	Floods, wetness	Wetness	Wetness.
Favorable	Droughty	Piping	Favorable.
Slope, depth to rock	Slope, rooting depth, droughty.	Slope, piping, depth to rock	Slope, droughty.
Slope, depth to rock	Slope, rooting depth, droughty.	Slope, piping, depth to rock	Slope, droughty.
Depth to rock, slope	Rooting depth, slope	Depth to rock, slope	Rooting depth, slope.
Poor outlets, wetness, floods	Floods, wetness	Wetness, piping	Wetness.
Depth to rock, percs slowly, slope.	Percs slowly, rooting depth, slope.	Depth to rock	Rooting depth.
Depth to rock, percs slowly, slope.	Percs slowly, rooting depth, slope.	Depth to rock, slope, percs slowly.	Slope, rooting depth.
Depth to rock, slope	Rooting depth, slope	Depth to rock, slope	Droughty, rooting depth, slope.
Depth to rock, percs slowly, slope.	Percs slowly, rooting depth, slope.	Slope, large stones, depth to rock.	Slope, large stones, rooting depth.
Depth to rock, slope	Rooting depth, slope	Slope, depth to rock, large stones.	Slope, rooting depth, large stones.
Depth to rock, percs slowly, slope.	Percs slowly, rooting depth, slope.	Slope, large stones, depth to rock.	Slope, large stones, rooting depth.
Favorable	Favorable	Piping	Favorable.

TABLE 10.—*Water*

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees
Hack—continued:		
16C, 17C	Slope	Piping
[1] 18D	Slope	Large stones, piping
Hankins:		
19E, 20E	Slope	Low strength, shrink-swell, compressible
Helter:		
21C, 21E, 21F	Slope	Piping, hard to pack
Laycock:		
[1] 22E, [1] 23E, [1] 23F:		
Laycock part	Slope, seepage	Seepage, piping
Logdell part	Slope, seepage	Seepage
Lemonex:		
24E	Depth to rock, slope	Low strength, shrink-swell, thin layer
[1] 25E:		
Lemonex part	Depth to rock, slope	Low strength, shrink-swell, thin layer
Rock outcrop part		
Lithic Xerochrepts part	Depth to rock, slope	Thin layer
Lickskillet:		
[1] 26F:		
Lickskillet part	Slope, depth to rock	Thin layer; large stones
Rock outcrop part		
Logdell:		
27F	Slope, seepage	Seepage
McGarr:		
28E, [1] 28F	Depth to rock, slope	Low strength, large stones, thin layer
[1] 29F:		
McGarr part	Depth to rock, slope	Low strength, large stones, thin layer
Anatone part	Slope, depth to rock	Thin layer, large stones
Oxbow:		
30B	Cemented pan	Low strength, large stones, shrink-swell
Oxwall:		
31B, 32B	Cemented pan	Large stones, thin layer, shrink-swell
Piersonte:		
[1] 33F:		
Piersonte part	Slope, seepage	Piping
Logdell part	Slope, seepage	Seepage
Laycock part	Slope, seepage	Seepage, piping
Powder:		
34	Seepage	Hard to pack, piping
Ricco:		
35	Favorable	Hard to pack, low strength, compressible

management—Continued

Drainage	Irrigation	Terraces and diversions	Grassed waterways
Slope	Slope	Piping	Favorable.
Slope	Slope	Slope, large stones, piping	Slope, large stones.
Percs slowly, slope	Percs slowly, slope	Percs slowly, slope	Percs slowly, slope.
Slope	Slope	Slope, piping	Slope.
Slope	Slope, droughty	Slope, piping	Slope, droughty.
Slope	Slope, droughty	Slope	Slope, droughty.
Percs slowly, slope, depth to rock.	Percs slowly, slope, rooting depth.	Depth to rock, slope, percs slowly.	Slope, percs slowly, rooting depth.
Percs slowly, slope, depth to rock.	Percs slowly, slope, rooting depth.	Depth to rock, slope, percs slowly.	Slope, percs slowly, rooting depth.
Depth to rock, slope	Rooting depth, slope	Depth to rock, slope	Rooting depth, slope.
Depth to rock, slope	Rooting depth, slope, large stones.	Depth to rock, large stones, slope.	Rooting depth, large stones, slope.
Slope	Slope, droughty	Slope	Slope, droughty.
Slope, depth to rock	Slope, rooting depth	Complex slope, depth to rock	Slope, rooting depth.
Slope, depth to rock	Slope, large stones, rooting depth.	Complex slope, depth to rock	Large stones, slope, rooting depth.
Depth to rock, slope	Rooting depth, slope, large stones.	Slope, depth to rock, large stones.	Rooting depth, slope, large stones.
Cemented pan, percs slowly	Percs slowly, rooting depth, large stones.	Cemented pan, large stones, percs slowly.	Large stones, percs slowly.
Cemented pan, percs slowly	Percs slowly, rooting depth, large stones.	Cemented pan, percs slowly, large stones.	Percs slowly, rooting depth, large stones.
Slope	Slope, droughty	Slope	Slope, droughty.
Slope	Slope, droughty	Slope	Slope, droughty.
Slope	Slope, droughty	Slope, piping	Slope, droughty.
Floods	Floods	Favorable	Favorable.
Floods, percs slowly, wetness	Floods, percs slowly, wetness.	Percs slowly, wetness	Percs slowly, wetness.

TABLE 10.—*Water*

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees
Rock outcrop:		
[1]36F:		
Rock outcrop part		
Lemonex part	Depth to rock, slope	Low strength, shrink-swell, thin layer
Lithic Xerochrepts part	Depth to rock, slope	Thin layer
Rockly:		
37D	Depth to rock, slope	Thin layer, large stones
Ruddley:		
[1]38E	Slope, depth to rock	Thin layer, piping
[1]39E:		
Ruddley part	Slope, depth to rock	Thin layer, piping
Rock outcrop part		
Lithic Xerochrepts part	Depth to rock, slope	Thin layer
Simas:		
40E	Slope	Low strength, shrink-swell, compressible
41E	Slope	Low strength, shrink-swell, compressible
[1]42E:		
Simas part	Slope	Low strength, shrink-swell, large stones
Day part	Slope	Shrink-swell, hard to pack, compressible
[1]43F:		
Simas part	Slope	Low strength, shrink-swell, large stones
Badland part		
[1]44E:		
Simas part	Slope	Low strength, shrink-swell, large stones
Tub part	Slope	Low strength, shrink-swell, large stones
Snell:		
45E	Slope, depth to rock	Shrink-swell, large stones, thin layer
[1]46E, [1]46F:		
Snell part	Slope, depth to rock	Shrink-swell, large stones, thin layer
Anatone part	Slope, depth to rock	Thin layer, large stones
Top:		
47E, 47F	Slope	Low strength, compressible, shrink-swell
Tub:		
48E, 48F	Slope	Piping, low strength, shrink-swell
49D	Slope	Piping, low strength, shrink-swell
Ukiah:		
50B	Slope, depth to rock	Low strength, shrink-swell, thin layer
51C	Slope, depth to rock	Low strength, shrink-swell, thin layer

management—Continued

Drainage	Irrigation	Terraces and diversions	Grassed waterways
Percs slowly, slope, depth to rock.	Percs slowly, slope, rooting depth.	Depth to rock, slope, percs slowly.	Slope, percs slowly, rooting depth.
Depth to rock, slope	Rooting depth, slope	Depth to rock, slope	Rooting depth, slope.
Depth to rock, slope	Rooting depth, slope, large stones.	Slope, depth to rock, large stones.	Slope, rooting depth, large stones.
Depth to rock, slope	Rooting depth, slope	Depth to rock, slope	Rooting depth, slope.
Depth to rock, slope	Rooting depth, slope	Depth to rock, slope	Rooting depth, slope.
Depth to rock, slope	Rooting depth, slope	Depth to rock, slope	Rooting depth, slope.
Percs slowly, slope	Percs slowly, slope	Percs slowly, slope	Percs slowly, slope.
Percs slowly, slope	Percs slowly, slope, large stones.	Large stones, slope, percs slowly.	Large stones, slope, percs slowly.
Percs slowly, slope	Percs slowly, slope, large stones.	Large stones, slope, percs slowly.	Large stones, slope, percs slowly.
Percs slowly, slope	Percs slowly, slope	Slope, percs slowly	Slope, percs slowly.
Percs slowly, slope	Percs slowly, slope, large stones.	Large stones, slope, percs slowly.	Large stones, slope, percs slowly.
Percs slowly, slope	Percs slowly, slope, large stones.	Large stones, slope, percs slowly.	Large stones, slope, percs slowly.
Percs slowly, slope	Percs slowly, slope, large stones.	Large stones, slope, percs slowly.	Large stones, slope, percs slowly.
Slope, depth to rock	Slope, large stones, rooting depth.	Depth to rock, large stones, slope.	Rooting depth, large stones, slope.
Slope, depth to rock	Slope, large stones, rooting depth.	Depth to rock, large stones, slope.	Rooting depth, large stones, slope.
Depth to rock, slope	Rooting depth, slope, large stones.	Slope, depth to rock, large stones.	Rooting depth, slope, large stones.
Slope	Slope	Slope	Slope.
Slope, percs slowly	Slope, slow intake, percs slowly.	Slope, percs slowly	Slope, percs slowly.
Slope, percs slowly	Slope, slow intake, percs slowly.	Percs slowly	Percs slowly.
Slope, depth to rock, percs slowly.	Slope, percs slowly, rooting depth.	Percs slowly, depth to rock	Percs slowly, rooting depth.
Percs slowly, slope, depth to rock.	Percs slowly, rooting depth, slope.	Percs slowly, large stones, depth to rock.	Percs slowly, large stones, rooting depth.

TABLE 10.—*Water*

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees
Ukiah—continued:		
52E	Slope, depth to rock	Low strength, shrink-swell, thin layer
Veazie:		
53	Seepage	Piping, low strength
Venator:		
54E	Slope, depth to rock	Thin layer, piping
[1] 55F:		
Venator part	Slope, depth to rock	Thin layer, piping
Rock outcrop part		
Waterbury:		
56E	Depth to rock, slope	Thin layer, low strength, shrink-swell
Wrightman:		
[1] 57D:		
Wrightman part	Depth to rock, slope	Thin layer, piping
Anatone part	Slope, depth to rock	Thin layer, large stones

[1] This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and

When making soil borings during field mapping, the soil scientist can identify several important soil properties. He notes the seasonal soil moisture condition, or the presence of free water and its depth in the profile. For each horizon, he notes the thickness of the soil and its color; the texture, or the amount of clay, silt, sand, and gravel or other coarse fragments; the structure, or natural pattern of cracks and pores in the undisturbed soil; and the consistence of soil in place under the existing soil moisture conditions. He records the root depth of existing plants, determines pH or reaction, and identifies any free carbonates.

Samples of soil material are analyzed in the laboratory to verify the field estimates of soil properties and to characterize key soils, especially properties that cannot be estimated accurately by field observation. Laboratory analyses are not conducted for all soil series in the survey area, but laboratory data for many of the soil series are available from nearby areas.

Based on summaries of available field and laboratory data, and listed in tables in this section, are estimated ranges in engineering properties and classifications and in physical and chemical properties for each major horizon of each soil in the survey area. Also, pertinent soil and water features, engineering test data, and data obtained from laboratory analyses, both physical and chemical, are presented.

Engineering properties

Table 12 gives estimates of engineering properties and classifications for the major horizons of each soil in the survey area. These estimates are presented as ranges in values most likely to exist in areas where the soil is mapped.

Most soils have, within the upper 5 or 6 feet, horizons of contrasting properties. Information is presented for each of these contrasting horizons. Depth to the upper and lower boundaries of each horizon in a typical profile of each soil is indicated. More information about the range in depth and in properties of each horizon is given for each soil series in "Descriptions of the Soils."

Texture is described in table 12 in standard terms used by the United States Department of Agriculture (USDA). These terms are defined according to percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loam." Other texture terms used by USDA are defined in the Glossary.

The two systems commonly used in classifying soils for engineering use are the Unified Soil Classification System (USCS) and the American Association of State Highway and Transportation Officials Soil Classification System (AASHTO). These classification systems are explained in PCA Soil Primer (*6*). In table 12 soils in the survey area are classified according to both systems.

The Unified system classifies soils according to properties that affect their use as construction material (*2*). Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter, plasticity index, liquid limit, and organic matter content. Soils are grouped into 15 classes—eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH and

management—Continued

Drainage	Irrigation	Terraces and diversions	Grassed waterways
Percs slowly, slope, depth to rock.	Percs slowly, rooting depth, slope.	Slope, depth to rock, large stones.	Percs slowly, large stones, slope.
Floods	Floods, droughty	Piping	Droughty.
Depth to rock, slope	Rooting depth, slope	Depth to rock, slope	Rooting depth, slope.
Depth to rock, slope	Rooting depth, slope	Depth to rock, slope	Rooting depth, slope.
Percs slowly, depth to rock, slope.	Percs slowly, rooting depth, slope.	Depth to rock, large stones, slope.	Large stones, rooting depth, slope.
Slope	Slope	Depth to rock, piping	Slope, rooting depth.
Depth to rock, slope	Rooting depth, slope, large stones.	Slope, depth to rock, large stones.	Rooting depth, slope, large stones.

behavior of the whole mapping unit.

OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes have a dual classification symbol, for example CL–ML.

The AASHTO system classifies soils according to those properties that affect their use in highway construction and maintenance (*1*). In this system a mineral soil is classified as one of seven basic groups ranging from A–1 through A–7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A–1 are coarse grained and low in content of fines. At the other extreme, in group A–7, are fine-grained soils. Highly organic soils are classified as A–8 on the basis of visual inspection.

When laboratory data are available, the A–1, A–2, and A–7 groups are further classified as follows: A–1–a, A–1–b, A–2–4, A–2–5, A–2–6, A–2–7, A–7–5, and A–7–6. As an additional refinement, the desirability of soils as subgrade material can be indicated by a group index number. These numbers range from 0 for the best subgrade material to 20 or more for the poorest. The estimated classification, without group index numbers, is given in table 12. Also in table 12 the percentage, by weight, of cobbles or the rock fragments more than 3 inches in diameter are estimated for each major horizon. These estimates are determined largely by observing volume percentage in the field and then converting it, by formula, to weight percentage.

Percentage of the soil material less than 3 inches in diameter that passes each of four standard sieves is estimated for each major horizon. The estimates are based on tests of soils that were sampled in the survey area and in nearby areas and on field estimates from many borings made during the survey.

Liquid limit and plasticity index indicate the effect of water on the strength and consistency of soil. These indexes are used in both the Unified and the AASHTO soil classification systems. They are also used as indicators in making general predictions of soil behavior.

Range in liquid limit and plasticity index are estimated on the basis of test data from the survey area or from nearby areas and on observations of the many soil borings made during the survey.

Physical and chemical properties

Table 13 shows estimated values for several soil characteristics and features that affect behavior of soils in engineering uses. These estimates are given for each major horizon, at the depths indicated, in the representative profile of each soil. The estimates are based on field observations and on test data for these and similar soils.

Permeability is estimated on the basis of known relationships between the soil characteristics observed in the field—particularly soil structure, porosity, and gradation or texture—that influence the downward movement of water in the soil. The estimates are for water movement in a vertical direction when the soil is saturated. Not considered in the estimates are lateral seepage or such transient soil features as plowpans and surface crusts. Permeability of the soil is an important factor to be considered in the planning and design of drainage systems, in evaluating the potential of soils for septic tank systems and other waste disposal systems, and in many other aspects of land use and management.

Available water capacity is rated on the basis of soil characteristics that influence the ability of the soil to hold water and make it available to plants. Important characteristics are content of organic mat-

TABLE 11.—*Recreational development*

["Percs slowly" and some of the other terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe"]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Alding:				
[1] 1F:				
Alding part	Severe: slope	Severe: slope	Severe: slope, depth to rock, small stones.	Severe: slope.
Rock outcrop part				
Lithic Xerochrepts part	Severe: slope	Severe: slope	Severe: depth to rock, slope.	Severe: slope.
Anatone:				
[1] 2D:				
Anatone part	Severe: large stones.	Moderate: large stones.	Severe: slope, depth to rock, large stones.	Severe: large stones.
Wrightman part	Moderate: slope	Moderate: slope	Severe: slope	Slight.
Balder:				
3C	Moderate: slope	Moderate: slope	Severe: slope, depth to rock.	Slight.
4F	Severe: slope	Severe: slope	Severe: slope, depth to rock.	Severe: slope.
Boyce:				
5	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness.
Courtrock:				
6B	Slight	Slight	Moderate: slope	Slight.
Daxty:				
7E	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
[1] 8E:				
Daxty part	Severe: slope	Severe: slope	Severe: slope, small stones.	Moderate: slope, small stones.
Rock outcrop part				
Lithic Xerochrepts part	Severe: slope	Severe: slope	Severe: depth to rock, slope.	Severe: slope.
Dayville:				
9	Moderate: wetness.	Moderate: wetness.	Moderate: floods, wetness.	Moderate: wetness.
Dumps:				
10				
Fopiano:				
11C	Moderate: percs slowly, slope, too clayey.	Moderate: too clayey, slope.	Severe: depth to rock, slope.	Moderate: too clayey.
11E	Severe: slope	Severe: slope	Severe: depth to rock, slope.	Severe: slope.
Grell:				
12E	Severe: slope, small stones.	Severe: small stones, slope.	Severe: slope, depth to rock, small stones.	Severe: small stones.
13E	Severe: slope, small stones.	Severe: small stones, slope.	Severe: slope, depth to rock, small stones.	Severe: small stones, slope.

TABLE 11.—*Recreational development*—Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Gwin:				
[1] 14E:				
Gwin part	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, depth to rock, small stones.	Severe: small stones.
Rockly part	Severe: slope, large stones.	Severe: slope	Severe: slope, small stones, depth to rock.	Severe: large stones.
[1] 14F:				
Gwin part	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, depth to rock, small stones.	Severe: slope, small stones.
Rockly part	Severe: slope, large stones.	Severe: slope	Severe: slope, small stones, depth to rock.	Severe: slope, large stones.
[1] 15F:				
Gwin part	Severe: slope, large stones, small stones.	Severe: slope, small stones.	Severe: depth to rock, slope, large stones.	Severe: slope, large stones, small stones.
Rock outcrop part				
Hack:				
16A	Moderate: percs slowly.	Slight	Moderate: percs slowly.	Slight.
16B	Moderate: percs slowly.	Slight	Moderate: slope, percs slowly.	Slight.
16C	Moderate: slope, percs slowly.	Moderate: slope	Severe: slope, percs slowly.	Slight.
17C	Moderate: slope, percs slowly.	Moderate: slope	Severe: slope	Slight.
[1] 18D	Severe: large stones.	Moderate: large stones.	Severe: slope	Severe: large stones.
Hankins:				
19E	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
20E	Severe: slope	Severe: slope	Severe: slope	Moderate: too clayey, slope.
Helter:				
21C	Moderate: slope	Moderate: slope	Severe: slope	Slight.
21E, 21F	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Laycock:				
[1] 22E, [1] 23E, [1] 23F:				
Laycock part	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.
Logdell part	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.
Lemonex:				
24E	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
[1] 25E:				
Lemonex part	Severe: slope	Severe: slope	Severe: slope	Moderate: slope, too clayey, large stones.
Rock outcrop part				
Lithic Xerochrepts part	Severe: slope	Severe: slope	Severe: depth to rock, slope.	Severe: slope.

TABLE 11.—*Recreational development*—Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Lickskillet:				
[1] 26F:				
Lickskillet part	Severe: slope, large stones.	Severe: slope	Severe: slope, large stones.	Severe: slope, large stones.
Rock outcrop part				
Logdell:				
27F	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.
McGarr:				
28E, [1] 28F	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
[1] 29F:				
McGarr part	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Anatone part	Severe: slope, large stones.	Severe: slope	Severe: slope, depth to rock, large stones.	Severe: slope, large stones.
Oxbow:				
30B	Moderate: large stones, percs slowly, too clayey.	Moderate: too clayey.	Moderate: too clayey, large stones, percs slowly.	Moderate: too clayey, large stones.
Oxwall:				
31B	Moderate: percs slowly, large stones, too clayey.	Moderate: too clayey.	Moderate: too clayey, large stones, percs slowly.	Moderate: too clayey, large stones.
32B	Severe: large stones.	Moderate: too clayey, large stones.	Severe: large stones.	Severe: large stones.
Piersonte:				
[1] 33F:				
Piersonte part	Severe: slope	Severe: slope	Severe: slope, small stones.	Severe: slope.
Logdell part	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.
Laycock part	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.
Powder:				
34	Moderate: floods.	Slight	Slight	Slight.
Ricco:				
35	Severe: wetness, floods.	Severe: wetness	Severe: wetness	Severe: wetness.
Rock outcrop:				
[1] 36F:				
Rock outcrop part				
Lemonex part	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Lithic Xerochrepts part	Severe: slope	Severe: slope	Severe: depth to rock, slope.	Severe: slope.
Rockly:				
37D	Severe: large stones.	Moderate: small stones.	Severe: slope, small stones, depth to rock.	Severe: large stones.
Ruddley:				
[1] 38E	Severe: slope	Severe: slope	Severe: slope, depth to rock.	Moderate: slope.

TABLE 11.—*Recreational development*—Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Ruddley—continued:				
[1]39E:				
Ruddley part	Severe: slope	Severe: slope	Severe: slope, depth to rock.	Moderate: slope.
Rock outcrop part				
Lithic Xerochrepts part	Severe: slope	Severe: slope	Severe: depth to rock, slope.	Severe: slope.
Simas:				
40E	Severe: slope	Severe: slope	Severe: slope	Moderate: too clayey, slope.
41E	Severe: slope	Severe: slope	Severe: slope	Moderate: slope, large stones, too clayey.
[1]42E:				
Simas part	Severe: slope	Severe: slope	Severe: slope	Moderate: slope, large stones, too clayey.
Day part	Severe: slope, too clayey.	Severe: slope, too clayey.	Severe: slope, too clayey.	Severe: too clayey.
[1]43F:				
Simas part	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Badland part				
[1]44E:				
Simas part	Severe: slope	Severe: slope	Severe: slope	Moderate: slope, large stones, too clayey.
Tub part	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Snell:				
45E	Severe: slope	Severe: slope	Severe: slope, large stones.	Severe: slope.
[1]46E:				
Snell part	Severe: slope	Severe: slope	Severe: slope, large stones.	Severe: slope.
Anatone part	Severe: slope, large stones, small stones.	Severe: slope, small stones.	Severe: slope, depth to rock, large stones.	Severe: slope, large stones, small stones.
[1]46F:				
Snell part	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones, depth to rock.	Severe: slope, large stones.
Anatone part	Severe: slope, large stones.	Severe: slope	Severe: slope, depth to rock, large stones.	Severe: slope, large stones.
Top:				
47E, 47F	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Tub:				
48E, 48F	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
49D	Moderate: slope, too clayey, percs slowly.	Moderate: slope, too clayey.	Severe: slope	Moderate: too clayey.
Ukiah:				
50B	Moderate: too clayey, percs slowly.	Moderate: too clayey.	Moderate: percs slowly, too clayey.	Moderate: too clayey.

TABLE 11.—*Recreational development*—Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Ukiah—continued:				
51C	Moderate: slope, large stones, too clayey.	Moderate: slope, too clayey.	Severe: slope	Moderate: too clayey, large stones.
52E	Severe: slope, large stones.	Severe: slope	Severe: slope, large stones.	Severe: large stones, slope.
Veazie:				
53	Severe: floods	Moderate: floods	Moderate: floods	Slight.
Venator:				
54E	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, depth to rock, small stones.	Severe: small stones.
[1] 55F:				
Venator part	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, depth to rock, small stones.	Severe: slope, small stones.
Rock outcrop part				
Waterbury:				
56E	Severe: large stones, percs slowly, slope.	Severe: slope	Severe: large stones, percs slowly, slope.	Severe: large stones.
Wrightman:				
[1] 57D:				
Wrightman part	Moderate: slope	Moderate: slope	Severe: slope	Slight.
Anatone part	Severe: large stones.	Moderate: large stones.	Severe: slope, depth to rock, large stones.	Severe: large stones.

[1] This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

ter, soil texture, and soil structure. Shallow-rooted plants are not likely to use the available water from the deeper soil horizons. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design of irrigation systems.

Soil reaction is expressed as range in pH values. The range in pH of each major horizon is based on many field checks. For many soils, the values have been verified by laboratory analyses. Soil reaction is important in selecting the crops and ornamental or other plants to be grown, in evaluating soil amendments for fertility and stabilization, and in evaluating the corrosivity of soils.

Salinity is in millimhos per centimeter at 25° C, expressed as the electrical conductivity of the saturation extract. Estimates are based on field and laboratory measurements at representative sites of the nonirrigated soils. The salinity of individual irrigated fields is largely affected by the quality of the irrigation water and the irrigation practices. Hence, the salinity of individual fields can differ greatly from the value given in table 13. Salinity affects the suitability of a soil for crop production, its stability when used as a construction material, and its potential to corrode metal and concrete.

Shrink-swell potential depends mainly on the amount and kind of clay in the soil. Laboratory measurements of the swelling of undisturbed clods were made for many soils. For others it was estimated on the basis of the kind of clay and on measurements of similar soils. Size of imposed loadings and the magnitude of changes in soil moisture content are also important factors that influence the swelling of soils. Shrinking and swelling of some soils can cause damage to building foundations, basement walls, roads, and other structures unless special designs are used. A *high* shrink-swell potential indicates that special design and added expense is required in places if the planned use of the soil does not tolerate large volume changes.

Risk of corrosion, as used in table 13, pertains to potential soil induced chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to soil moisture, particle-size distribution, total acidity, and electrical conductivity of the soil material. The rating of soils for corrosivity to concrete is based mainly on the sulfate content, soil texture, and acidity. Protective measures for steel or more resistant concrete help to avoid or minimize damage resulting from the corrosion. Installations of steel that intersect soil boundaries or soil horizons are more susceptible to corrosion than installations entirely within one kind of soil or one soil horizon.

Soil erodibility factor (K) is used in the universal soil loss equation, and it is a measure of the susceptibility of soil particles to detachment and transport by rainfall and runoff. It is a value determined by experiment on selected soils. Based on a knowledge of the behavior of soils, their properties, and interactions, these data are synthesized and values assigned to other soils.

Soil loss tolerance (T), sometimes called permissible soil loss, is the maximum rate of soil erosion (whether by rainfall or by soil blowing) that permits a high level of crop productivity to be sustained economically and indefinitely. It can also be used to determine the permissible soil loss in construction areas.

Soil loss tolerance is related to soil depth and the ability of the soil to replace the lost soil material.

Soil and water features

Features that relate to runoff or infiltration of water, to flooding, to grading and excavation, and to frost action of each soil are indicated in table 14. This information is helpful in planning land uses and engineering projects that are likely to be affected by the amount of runoff from watersheds, by flooding and a seasonal high water table, by the presence of bedrock or a cemented pan in the upper 5 or 6 feet of the soil, or by frost action.

Hydrologic groups are used to estimate runoff after rainfall. Soil properties that influence the minimum rate of infiltration into the bare soil after prolonged wetting are depth to a water table, water intake rate and permeability after prolonged wetting, and depth to layers of slowly or very slowly permeable soil.

In the column headed "Hydrologic group," the soils are placed in one of four groups on the basis of intake of water at the end of long duration storms occurring after prior wetting and opportunity for swelling and without the protective effects of vegetation. The groups range from open sands that have the lowest runoff potential (Group A) to heavy clays that have the highest runoff potential (Group D). Descriptions of these four groups are as follows:

Group A.—Soils having high infiltration rates, even when thoroughly wetted, and consisting chiefly of deep, well drained to excessively drained sands, gravel, or both. These soils have a high rate of water transmission and a low runoff potential.

Group B.—Soils having moderate infiltration rates when thoroughly wetted, and consisting chiefly of moderately deep to deep, moderately well drained to well drained soils that are moderately fine textured to moderately coarse textured. These soils have a moderate rate of water transmission and a moderate runoff potential.

Group C.—Soils having slow infiltration rates when thoroughly wetted and consisting chiefly of either soils that have a layer that impedes the downward movement of water or moderately fine textured to fine textured soils that have a slow infiltration rate. These soils have a slow rate of water transmission and a high runoff potential.

Group D.—Soils having very slow infiltration rates when thoroughly wetted. They consist chiefly of clay soils that have a high swelling potential, soils that have a high permanent water table, soils that have a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very slow rate of water transmission and a very high runoff potential.

Flooding is rated in general terms that describe the frequency, duration, and period of the year when flooding is most likely to occur. The ratings are based on evidences in the soil profile or the effects of flooding, namely thin strata of gravel, sand, silt, or, in places, clay deposited by floodwater; irregular decrease in organic matter content as depth increases; absence of distinctive soil horizons that form in soils of the survey area that are not subject to flooding; local information about floodwater heights and the extent of flooding; and local knowledge that relates the unique landscape position of each soil to historic floods. Most soils in low positions on the landscape where flooding is likely to occur are classified as fluvents at the suborder level or as fluventic subgroups. See the subsection "Classification."

The generalized description of flood hazards is of value in land use planning and provides a valid basis for land use restrictions. The soil data are less specific, however, than those provided by detailed engineering surveys that delineate flood prone areas at specific flood frequency levels.

The *high water table* is the highest level of a saturated zone more than 6 inches thick for a continuous period of more than 2 weeks during most years. The depth to a seasonal high water table applies to undrained soils. Estimates are based mainly on the relationship between grayish colors or mottles in the soil and the depth to free water observed during the course of the soil survey. Indicated are the depth to the seasonal high water table; the kind of water table, whether perched, artesian, or the upper part of the ground water table; and the months of the year that the high water commonly is present. Only those saturated zones above a depth of 5 or 6 feet are indicated.

Information about the seasonal high water table helps in assessing the need for specially designed foundations, the need for specific kinds of drainage systems, and the need for footing drains to ensure dry basements. Such information is also needed to decide whether or not to construct basements and to determine how septic tank absorption fields and other underground installations will function. Also, a seasonal high water table affects ease of excavation.

Depth to bedrock is shown for all soils that are underlain by bedrock at a depth of 5 to 6 feet or less. For many soils, limited ranges in depth to bedrock is a part of the definition of the soil series. The depths shown are based on measurements made in many soil borings and other observations during mapping. The kind of bedrock and its relative hardness as related to ease of excavation is also shown. Rippable bedrock can be excavated with a single tooth ripping attachment on a 200 horsepower tractor, but hard bedrock generally requires blasting.

Cemented pans are hard subsurface layers that are strongly compacted (indurated). Such pans cause difficulty in excavation. Hardness of pans is defined the same as hardness of bedrock.

Potential frost action refers to the likelihood of damage to pavements and other structures by frost

TABLE 12.—*Engineering properties*

[The symbol > means greater than. Absence

Soil name and map symbol	Depth	USDA texture	Classification	
			Unified	AASHTO
	In			
Alding:				
[1] 1F:				
Alding part	0–10	Gravelly loam	GM, ML	A–2, A–4
	10–16	Gravelly clay	GC, CH	A–7
	16	Weathered bedrock		
Rock outcrop part				
Lithic Xerochrepts part	0–8	Variable		
	8	Unweathered bedrock		
Anatone:				
[1] 2D:				
Anatone part	0–3	Extremely stony loam	GM, GM-GC	A–2, A–4
	3–11	Very gravelly silt loam, very cobbly loam	GM, GM-GC	A–2
	11	Unweathered bedrock		
Wrightman part	0–25	Loam	ML, CL–ML	A–4
	25	Unweathered bedrock		
Balder:				
3C	0–16	Stony loam	ML, SM	A–4
	16	Weathered bedrock		
4F	0–16	Very stony loam	ML, SM	A–4
	16	Weathered bedrock		
Boyce:				
5	0–31	Silty clay loam	ML	A–7, A–4, A–6
	31–42	Loamy sand	SM	A–1, A–2
	42–60	Very gravelly sand	GP	A–1
Courtrock:				
6B	0–33	Loam	ML	A–4
	33–50	Loam, gravelly loam	ML, GM	A–4
	50–60	Very gravelly sand	GP-GM, SP-SM	A–1
Daxty:				
7E	0–7	Loam	ML, SM	A–4
	7–26	Very flaggy loam	GM, SM	A–4, A–2
	26	Weathered bedrock		
[1] 8E:				
Daxty part	0–7	Very flaggy loam	ML, SM	A–4
	7–26	Very flaggy loam	GM, SM	A–4, A–2
	26	Weathered bedrock		
Rock outcrop part				
Lithic Xerochrepts part	0–8	Variable		
	8	Unweathered bedrock		
Dayville:				
9	0–36	Silt loam	ML	A–4
	36–60	Sand and gravel	GW, GP, SW, SP	A–1
Dumps:				
10				
Fopiano:				
11C, 11E	0–5	Silty clay loam	ML, CL	A–4, A–6
	5–15	Clay	CH	A–7
	15	Weathered bedrock		
Grell:				
12E, 13E	0–17	Very gravelly loam	GM	A–2
	17	Unweathered bedrock		

and classifications

of an entry means data were not estimated]

Fragments >3 inches	Percentage passing sieve number—				Liquid limit	Plasticity index
	4	10	40	200		
Pct					*Pct*	
0–5	60–75	50–75	40–75	30–60	30–40	5–10
0–5	60–75	50–70	45–70	40–65	50–65	30–40
30–50	50–60	40–50	35–45	25–40	25–40	5–10
20–60	40–50	30–40	30–40	20–35	25–40	5–10
0–10	95–100	90–100	75–95	55–85	25–35	5–10
10–30	75–100	70–100	60–95	40–75	25–35	NP–5
10–30	75–100	70–100	60–95	40–75	25–35	NP–5
0	100	100	90–100	80–95	30–50	5–15
0	80–90	80–85	40–65	15–25		NP
0	35–50	25–40	10–30	0–5		NP
0	80–100	75–100	70–90	50–70		NP
0–15	60–90	55–85	45–75	35–60		NP
10–25	45–80	40–50	20–30	5–10		NP
0–15	80–100	75–95	65–80	45–60		NP
50–60	55–85	50–75	40–70	30–50		NP
50–60	80–100	75–95	65–80	45–60		NP
50–60	55–85	50–75	40–70	30–50		NP
0	100	100	90–100	80–90	25–30	NP–5
0–15	30–90	20–85	10–35	0–5		NP
0–5	80–100	75–100	65–100	50–95	30–40	5–15
0–5	80–100	75–100	65–100	55–95	50–70	25–40
0–15	30–55	25–50	20–50	15–35	30–35	5–10

TABLE 12.—*Engineering properties*

Soil name and map symbol	Depth	USDA texture	Classification	
			Unified	AASHTO
	In			
Gwin:				
[1] 14E, [1] 14F:				
Gwin part	0–3	Very stony silt loam	GM	A–2, A–4
	3–13	Very cobbly silty clay loam	GM	A–2, A–4, A–6
	13	Unweathered bedrock		
Rockly part	0–4	Extremely stony loam	GM	A–2, A–4
	4–8	Very cobbly clay loam, very gravelly clay loam.	GM	A–2, A–6
	8	Unweathered bedrock		
[1] 15F:				
Gwin part	0–3	Extremely stony silt loam	GM	A–2, A–4
	3–13	Very cobbly silty clay loam	GM	A–2, A–4, A–6
	13	Unweathered bedrock		
Rock outcrop part				
Hack:				
16A, 16B, 16C	0–14	Loam	ML	A–4
	14–60	Loam, clay loam, gravelly clay loam	ML, GM	A–4
17C	0–14	Gravelly loam	ML, GM	A–4
	14–60	Loam, clay loam, gravelly clay loam	ML, GM	A–4
[1] 18D	0–14	Extremely stony loam	ML, GM	A–4
	14–60	Loam, clay loam, gravelly clay loam	ML, GM	A–4
Hankins:				
19E	0–10	Silt loam	ML	A–6, A–4
	10–60	Clay	CH	A–7
20E	0–10	Silty clay loam	ML	A–6, A–4
	10–60	Clay	CH	A–7
Helter:				
21C, 21E, 21F	0–23	Silt loam	ML	A–4
	23–60	Silt loam, silty clay loam	ML	A–6
Laycock:				
[1] 22E, [1] 23E, [1] 23F:				
Laycock part	0–17	Very shaly loam	GM, SM	A–2, A–1
	17–60	Fragmental	GP	A–1
Logdell part	0–8	Very shaly loam	SM	A–2, A–1
	8–60	Fragmental	GP	A–1
Lemonex:				
24E	0–8	Stony clay loam	CL	A–7
	8–27	Gravelly clay	CH	A–7
	27	Unweathered bedrock		
[1] 25E:				
Lemonex part	0–8	Very stony clay loam	CL	A–7
	8–27	Gravelly clay	CH	A–7
	27	Unweathered bedrock		
Rock outcrop part				
Lithic Xerochrepts part	0–8	Variable		
	8	Unweathered bedrock		
Lickskillet:				
[1] 26F:				
Lickskillet part	0–8	Extremely stony loam	GM–GC, CL–ML	A–4
	8–15	Very gravelly clay loam, very gravelly loam	GC	A–2, A–6, A–7
	15	Unweathered bedrock		
Rock outcrop part				

and classifications—Continued

Fragments >3 inches	Percentage passing sieve number—				Liquid limit	Plasticity index
	4	10	40	200		
Pct					*Pct*	
45–70	45–60	35–55	35–55	30–50	25–30	NP–5
50–70	45–60	35–55	35–55	30–50	30–40	5–15
30–60	50–75	40–70	35–65	25–50	15–20	NP–5
30–60	50–75	30–70	25–70	20–50	35–40	10–15
45–70	45–60	35–55	35–55	30–50	25–30	NP–5
50–70	45–60	35–55	35–55	30–50	30–40	5–15
0–5	80–95	75–90	70–85	50–70	30–35	NP–10
0–5	65–95	60–90	60–90	45–70	30–40	5–10
0–5	65–80	60–75	55–70	35–55	30–35	NP–10
0–5	65–95	60–90	60–90	45–70	30–40	5–10
15–30	65–85	60–80	50–75	35–60	30–35	NP–10
0–5	65–95	60–90	60–90	45–70	30–40	5–10
0–5	90–100	85–100	85–100	70–95	30–40	5–15
0–15	90–100	85–100	85–100	65–95	50–65	25–35
0–5	90–100	85–100	85–100	70–95	30–40	5–15
0–15	90–100	85–100	85–100	65–95	50–65	25–35
0	100	100	95–100	85–95		NP
0	100	100	95–100	85–95	35–40	10–15
5–15	30–70	20–50	15–40	10–30	25–35	NP–10
5–40	5–20	0–10	0–5	0		NP
0–15	65–75	25–50	20–45	15–35	25–35	NP–5
5–40	5–20	0–10	0–5	0		NP
10–20	75–95	70–95	65–85	60–80	40–45	15–20
10–15	65–90	60–75	55–70	50–65	50–65	25–35
15–25	75–95	70–95	65–85	60–80	40–45	15–20
10–15	65–90	60–75	55–70	50–65	50–65	25–35
30–50	60–90	60–85	50–80	35–65	25–30	5–10
15–35	40–65	25–50	20–50	15–40	35–45	15–20

TABLE 12.—*Engineering properties*

Soil name and map symbol	Depth	USDA texture	Classification	
			Unified	AASHTO
	In			
Logdell:				
27F	0–8	Very shaly loam	SM	A–2, A–1
	8–60	Fragmental	GP	A–1
McGarr:				
28E, [1] 28F	0–14	Stony loam	ML	A–4
	14–31	Silty clay loam, cobbly silty clay loam, cobbly clay loam.	CL	A–6
	31	Unweathered bedrock		
[1] 29F:				
McGarr part	0–14	Very stony loam	ML	A–4
	14–31	Silty clay loam, cobbly silty clay loam, cobbly clay loam.	CL	A–6
	31	Unweathered bedrock		
Anatone part	0–3	Extremely stony loam	GM, GM–GC	A–2, A–4
	3–11	Very gravelly silt loam, very cobbly loam	GM, GM–GC	A–2
	11	Unweathered bedrock		
Oxbow:				
30B	0–12	Very stony silty clay loam	CL	A–7
	12–27	Clay, gravelly clay	CH	A–7
	27	Indurated		
Oxwall:				
31B	0–8	Very stony silty clay loam	CL	A–7
	8–13	Clay, gravelly clay, very stony clay	CH	A–7
	13	Indurated		
32B	0–8	Extremely stony silty clay loam	CL	A–7
	8–13	Clay, gravelly clay, very stony clay	CH	A–7
	13	Indurated		
Piersonte:				
[1] 33F:				
Piersonte part	0–10	Shaly loam	GM, SM	A–2, A–4
	10–60	Very shaly loam	GM, SM	A–2, A–4, A–1
Logdell part	0–8	Very shaly loam	SM	A–2, A–1
	8–60	Fragmental	GP	A–1
Laycock part	0–17	Very shaly loam	GM, SM	A–2, A–1
	17–60	Fragmental	GP	A–1
Powder:				
34	0–32	Silt loam	ML	A–4
	32–60	Silt loam, very fine sandy loam	ML	A–4
Ricco:				
35	0–15	Silty clay loam	ML	A–7
	15–72	Silty clay loam	MH	A–7
Rock outcrop:				
[1] 36F:				
Rock outcrop part				
Lemonex part	0–8	Very stony clay loam	CL	A–7
	8–27	Gravelly clay	CH	A–7
	27	Unweathered bedrock		
Lithic Xerochrepts part	0–8	Variable		
	8	Unweathered bedrock		
Rockly:				
37D	0–4	Extremely stony loam	GM	A–2, A–4
	4–8	Very cobbly clay loam, very gravelly clay loam.	GM	A–2, A–6
	8	Unweathered bedrock		

and classifications—Continued

Fragments >3 inches	Percentage passing sieve number—				Liquid limit	Plasticity index
	4	10	40	200		
Pct					*Pct*	
0–15 5–40	65–75 5–20	25–50 0–10	20–45 0–5	15–35 0	25–35	NP–5 NP
25–30 10–30	80–100 80–100	75–95 65–90	65–90 60–90	50–70 55–85	30–40 30–40	NP–10 10–20
50–60 10–30	90–100 80–100	75–95 65–90	70–95 60–90	55–75 55–85	30–40 30–40	NP–10 10–20
30–50 20–60	50–60 40–50	40–50 30–40	35–45 30–40	25–40 20–35	25–40 25–40	5–10 5–10
25–40 5–15	80–100 75–100	75–100 70–100	70–100 65–100	65–95 50–95	40–50 55–70	15–25 30–40
20–30 5–30	90–100 80–100	85–100 70–100	80–100 65–100	70–95 50–95	40–50 55–70	15–25 30–40
30–40 5–30	90–100 80–100	85–100 70–100	80–100 65–100	70–95 50–95	40–50 55–70	15–25 30–40
0–10 10–15	55–80 40–70	50–70 20–50	40–65 15–45	30–50 10–40	25–35 25–35	NP–10 NP–10
0–15 5–40	65–75 5–20	25–50 0–10	20–45 0–5	15–35 0	25–35	NP–5 NP
5–15 5–40	30–70 5–20	20–50 0–10	15–40 0–5	10–30 0	25–35	NP–10 NP
0 0	100 100	100 90–100	95–100 85–100	85–95 60–90	20–25 20–25	NP–5 NP–5
0 0	100 100	100 100	95–100 95–100	85–95 85–95	40–50 50–60	10–15 15–25
15–25 10–15	75–95 65–90	70–95 60–75	65–85 55–70	60–80 50–65	40–45 50–65	15–20 25–35
30–60 30–60	50–75 50–75	40–70 30–70	35–65 25–70	25–50 20–50	15–20 35–40	NP–5 10–15

TABLE 12.—*Engineering properties*

Soil name and map symbol	Depth	USDA texture	Classification	
			Unified	AASHTO
	In			
Ruddley:				
[1]38E	0–8	Loam	ML	A–4
	8–18	Clay loam, gravelly clay loam	CL, GC	A–6, A–7
	18	Weathered bedrock		
[1]39E:				
Ruddley part	0–8	Loam	ML	A–4
	8–18	Clay loam, gravelly clay loam	CL, GC	A–6, A–7
	18	Weathered bedrock		
Rock outcrop part				
Lithic Xerochrepts part	0–8	Variable		
	8	Unweathered bedrock		
Simas:				
40E	0–5	Clay loam	ML	A–4, A–6
	5–21	Clay, gravelly clay, cobbly clay	CH, GC	A–7
	21–60	Gravelly clay, cobbly clay, gravelly clay loam.	CH, GC	A–7
41E	0–5	Very stony clay loam	ML	A–4, A–6
	5–21	Clay, gravelly clay, cobbly clay	CH, GC	A–7
	21–60	Gravelly clay, cobbly clay, gravelly clay loam.	CH, GC	A–7
[1]42E:				
Simas part	0–5	Very stony clay loam	ML	A–4, A–6
	5–21	Clay, gravelly clay, cobbly clay	CH, GC	A–7
	21–60	Gravelly clay, cobbly clay, gravelly clay loam.	CH, GC	A–7
Day part	0–43	Clay	CH	A–7
	43	Weathered bedrock		
[1]43F:				
Simas part	0–5	Very stony clay loam	ML	A–4, A–6
	5–21	Clay, gravelly clay, cobbly clay	CH, GC	A–7
	21–60	Gravelly clay, cobbly clay, gravelly clay loam.	CH, GC	A–7
Badland part				
[1]44E:				
Simas part	0–5	Very stony clay loam	ML	A–4, A–6
	5–21	Clay, gravelly clay, cobbly clay	CH, GC	A–7
	21–60	Gravelly clay, cobbly clay, gravelly clay loam.	CH, GC	A–7
Tub part	0–8	Very stony clay loam	CL	A–7
	8–23	Gravelly clay, clay	CH	A–7
	23–60	Gravelly clay loam, silty clay loam	CH	A–7
Snell:				
45E	0–10	Very stony loam	ML, SM	A–5
	10–23	Very stony clay loam, very stony clay	SM, SC, GC, GM	A–7
	23	Unweathered bedrock		
[1]46E, [1]46F:				
Snell part	0–10	Very stony loam	ML, SM	A–5
	10–23	Very stony clay loam, very stony clay	SM, SC, GC, GM	A–7
	23	Unweathered bedrock		
Anatone part	0–3	Extremely stony loam	GM, GM–GC	A–2, A–4
	3–11	Very gravelly silt loam, very cobbly loam	GM, GM–GC	A–2
	11	Unweathered bedrock		

and classifications—Continued

Fragments >3 inches	Percentage passing sieve number—				Liquid limit	Plasticity index
	4	10	40	200		
Pct					*Pct*	
0	85–100	85–100	75–95	50–75	25–35	NP–10
0	60–85	55–85	50–85	40–65	35–45	15–20
0	85–100	85–100	75–95	50–75	25–35	NP–10
0	60–85	55–85	50–85	40–65	35–45	15–20
0–15	80–100	75–100	70–100	65–95	30–40	5–15
0–45	60–100	55–100	50–100	40–95	50–70	25–40
15–40	65–100	55–85	55–80	45–80	50–70	25–40
15–45	80–100	75–100	65–100	50–95	30–40	5–15
0–45	60–100	55–100	50–100	40–95	50–70	25–40
15–40	65–100	55–85	55–80	45–80	50–70	25–40
15–45	80–100	75–100	65–100	50–95	30–40	5–15
0–45	60–100	55–100	50–100	40–95	50–70	25–40
15–40	65–100	55–85	55–80	45–80	50–70	25–40
0	90–100	90–100	80–100	70–95	60–75	30–45
15–45	80–100	75–100	65–100	50–95	30–40	5–15
0–45	60–100	55–100	50–100	40–95	50–70	25–40
15–40	65–100	55–85	55–80	45–80	50–70	25–40
15–45	80–100	75–100	65–100	50–95	30–40	5–15
0–45	60–100	55–100	50–100	40–95	50–70	25–40
15–40	65–100	55–85	55–80	45–80	50–70	25–40
15–40	85–90	80–90	70–90	55–70	40–50	15–25
0–25	80–95	60–75	55–75	50–70	50–70	25–40
0–25	80–95	60–75	55–65	50–60	50–60	25–35
15–30	75–90	70–85	60–80	40–60	40–50	5–10
15–30	65–80	50–60	40–55	35–50	65–75	30–45
15–30	75–90	70–85	60–80	40–60	40–50	5–10
15–30	65–80	50–60	40–55	35–50	65–75	30–45
30–50	50–60	40–50	35–45	25–40	25–40	5–10
20–60	40–50	30–40	30–40	20–35	25–40	5–10

TABLE 12.—*Engineering properties*

Soil name and map symbol	Depth	USDA texture	Classification	
			Unified	AASHTO
	In			
Top:				
47E, 47F	0–5	Silt loam	ML	A–4
	5–36	Silty clay, clay, silty clay loam	CL	A–7
	36–45	Clay loam	ML	A–6
	45	Unweathered bedrock		
Tub:				
48E, 48F	0–8	Clay loam	CL	A–7
	8–23	Gravelly clay, clay	CH	A–7
	23–60	Gravelly clay loam, silty clay loam	CH	A–7
49D	0–8	Stony clay loam	CL, SC	A–7
	8–23	Gravelly clay, clay	CH	A–7
	23–60	Gravelly clay loam, silty clay loam	CH	A–7
Ukiah:				
50B	0–6	Stony silty clay loam	ML	A–7
	6–30	Cobbly clay, clay	CH	A–7
	30	Weathered bedrock		
51C	0–6	Very stony silty clay loam	ML	A–7
	6–30	Cobbly clay, clay	CH	A–7
	30	Weathered bedrock		
52E	0–6	Extremely stony silty clay loam	ML	A–7
	6–30	Cobbly clay, clay	CH	A–7
	30	Weathered bedrock		
Veazie:				
53	0–24	Loam	ML	A–4
	24–60	Very gravelly sand	GP–GM, GP	A–1
Venator:				
54E	0–5	Very shaly loam	GM	A–1, A–2
	5–12	Very shaly clay loam, very shaly loam	GM	A–2, A–1
	12	Unweathered bedrock		
[1] 55F:				
Venator part	0–5	Very shaly loam	GM	A–1, A–2
	5–12	Very shaly clay loam, very shaly loam	GM	A–2, A–1
	12	Unweathered bedrock		
Rock outcrop part				
Waterbury:				
56E	0–4	Extremely stony silty clay loam	CL	A–7
	4–15	Very cobbly clay	CH	A–7
	15	Unweathered bedrock		
Wrightman:				
[1] 57D:				
Wrightman part	0–25	Loam	ML, CL–ML	A–4
	25	Unweathered bedrock		
Anatone part	0–3	Extremely stony loam	GM, GM–GC	A–2, A–4
	3–11	Very gravelly silt loam, very cobbly loam	GM, GM–GC	A–2
	11	Unweathered bedrock		

[1] This mapping unit is made up of two or more dominant kinds of soil. See mapping unit descriptions for the composition and

and classifications—Continued

Fragments >3 inches	Percentage passing sieve number—				Liquid limit	Plasticity index
	4	10	40	200		
Pct					*Pct*	
0	100	100	90–100	80–90	30–35	5–10
0–5	95–100	90–100	85–100	75–95	40–50	15–25
0–5	75–100	70–100	65–100	50–80	35–40	10–15
0	85–95	75–95	75–95	55–75	40–50	15–25
0–25	80–95	60–75	55–75	50–70	50–70	25–40
0–25	80–95	60–75	55–65	50–60	50–60	25–35
0–25	80–95	60–75	55–65	45–55	40–50	15–25
0–25	80–95	60–75	55–75	50–70	50–70	25–40
0–25	80–95	60–75	55–65	50–60	50–60	25–35
25–40	80–100	75–100	70–100	65–95	40–50	10–15
15–40	80–100	75–100	70–100	65–95	50–60	25–35
25–50	80–100	75–100	70–100	65–95	40–50	10–15
15–40	80–95	75–90	70–90	55–85	50–60	25–35
40–60	80–100	75–100	70–100	65–95	40–50	10–15
15–40	80–95	75–90	70–90	55–85	50–60	25–35
0	95–100	90–100	75–95	55–75	25–30	NP–5
30–50	30–55	25–50	10–35	0–10		NP
0	40–60	30–50	25–50	20–35	25–40	NP–10
0	25–40	20–35	20–35	10–30	25–40	NP–10
0	40–60	30–50	25–50	20–35	25–40	NP–10
0	25–40	20–35	20–35	10–30	25–40	NP–10
60–70	80–95	75–90	70–90	65–85	40–50	15–25
50–75	65–90	60–85	55–85	50–80	50–60	25–35
0–10	95–100	90–100	75–95	55–85	25–35	5–10
30–50	50–60	40–50	35–45	25–40	25–40	5–10
20–60	40–50	30–40	30–40	20–35	25–40	5–10

behavior of the whole mapping unit.

TABLE 13.—*Physical and chemical*

[Dashes indicate the feature is not of concern. The symbol < means less than; > means greater than. The

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction
	In	*In/hr*	*In/in*	*pH*
Alding:				
[1] 1F:				
Alding part	0–10	0.6–2.0	0.10–0.14	6.6–7.3
	10–16	0.06–0.2	0.09–0.14	6.6–7.3
	16			
Rock outcrop part.				
Lithic Xerochrepts part	0–8			
	8			
Anatone:				
[1] 2D:				
Anatone part	0–3	0.6–2.0	0.08–0.10	6.1–7.3
	3–11	0.6–2.0	0.09–0.12	6.1–7.3
	11			
Wrightman part	0–25	0.6–2.0	0.15–0.21	6.1–7.3
	25			
Balder:				
3C, 4F	0–16	0.6–2.0	0.10–0.17	6.6–7.3
	16			
Boyce:				
5	0–31	0.6–2.0	0.19–0.21	7.4–8.4
	31–42	2.0–6.0	0.06–0.08	7.4–7.8
	42–60	6.0–20	0.03–0.05	7.4–7.8
Courtrock:				
6B	0–33	2.0–6.0	0.12–0.18	6.6–7.8
	33–50	2.0–6.0	0.10–0.16	7.9–8.4
	50–60	>20	0.03–0.05	7.4–7.8
Daxty:				
7E	0–7	0.6–2.0	0.05–0.10	6.1–6.5
	7–26	0.6–2.0	0.05–0.10	6.1–7.3
	26			
[1] 8E:				
Daxty part	0–7	0.6–2.0	0.05–0.10	6.1–6.5
	7–26	0.6–2.0	0.05–0.10	6.1–7.3
	26			
Rock outcrop part.				
Lithic Xerochrepts part	0–8			
	8			
Dayville:				
9	0–36	0.6–2.0	0.19–0.21	7.9–8.4
	36–60	6.0–20	0.03–0.05	7.9–8.4
Dumps:				
10.				
Fopiano:				
11C, 11E	0–5	0.2–0.6	0.16–0.20	6.6–7.3
	5–15	0.06–0.2	0.12–0.15	6.6–7.3
	15			
Grell:				
12E, 13E	0–17	0.6–2.0	0.06–0.13	6.6–7.3
	17			

properties of soils

erosion tolerance factor (T) is for the entire profile. Absence of an entry means data were not estimated]

Salinity	Shrink-swell potential	Risk of corrosion		Erosion factors	
		Uncoated steel	Concrete	K	T
Mmhos/cm					
	Moderate	Moderate	Low	0.20	1
	High	Moderate	Low	0.24	
	Low	Moderate	Low	0.20	1
	Low	Moderate	Low	0.20	
	Moderate	Moderate	Low	0.37	2
	Low	Moderate	Low	0.24	1
<2	Moderate	High	Low		
<2	Low	High	Low		
<2	Low	High	Low		
<2	Low	High	Low	0.32	5
<2	Low	High	Low	0.32	
<2	Low	High	Low	0.10	
	Low	Moderate	Low	0.20	2
	Low	Moderate	Low	0.24	
	Low	Moderate	Low	0.20	2
	Low	Moderate	Low	0.24	
<2	Low	High	Low		
<2	Low	High	Low		
	Moderate	Moderate	Low	0.37	1
	High	Moderate	Low	0.24	
	Low	Moderate	Low	0.28	1

TABLE 13.—*Physical and chemical*

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction
	In	*In/hr*	*In/in*	*pH*
Gwin:				
[1] 14E, [1] 14F:				
Gwin part	0–3	0.6–2.0	0.08–0.11	6.6–7.3
	3–13	0.2–0.6	0.07–0.11	6.6–7.3
	13			
Rockly part	0–4	0.6–2.0	0.06–0.11	6.1–7.3
	4–8	0.2–0.6	0.06–0.11	6.1–7.3
	8			
[1] 15F:				
Gwin part	0–3	0.6–2.0	0.08–0.11	6.6–7.3
	3–13	0.2–0.6	0.07–0.11	6.6–7.3
	13			
Rock outcrop part.				
Hack:				
16A, 16B, 16C, 17C	0–14	0.6–2.0	0.13–0.18	6.6–7.3
	14–60	0.2–0.6	0.16–0.21	6.6–8.4
[1] 18D	0–14	0.6–2.0	0.13–0.16	6.6–7.3
	14–60	0.2–0.6	0.16–0.21	6.6–8.4
Hankins:				
19E, 20E	0–10	0.2–0.6	0.11–0.21	6.1–7.3
	10–60	0.06–0.2	0.10–0.14	6.1–7.3
Helter:				
21C, 21E, 21F	0–23	0.6–2.0	0.24–0.38	5.6–6.5
	23–60	0.2–0.6	0.15–0.20	5.6–6.5
Laycock:				
[1] 22E, [1] 23E, [1] 23F:				
Laycock part	0–17	0.6–2.0	0.05–0.12	6.1–6.5
	17–60	>6.0	0.01–0.02	6.1–6.5
Logdell part	0–8	0.6–2.0	0.06–0.14	6.1–7.3
	8–60	>6.0	0.01–0.02	6.1–7.3
Lemonex:				
24E	0–8	0.2–0.6	0.11–0.17	6.6–7.3
	8–27	0.06–0.2	0.09–0.15	6.6–7.3
	27			
[1] 25E:				
Lemonex part	0–8	0.2–0.6	0.11–0.17	6.6–7.3
	8–27	0.06–0.2	0.09–0.15	6.6–7.3
	27			
Rock outcrop part.				
Lithic Xerochrepts part	0–8			
	8			
Lickskillet:				
[1] 26F:				
Lickskillet part	0–8	0.6–2.0	0.08–0.14	6.1–7.3
	8–15	0.6–2.0	0.06–0.14	6.6–7.3
	15			
Rock outcrop part.				
Logdell:				
27F	0–8	0.6–2.0	0.06–0.14	6.1–7.3
	8–60	>6.0	0.01–0.02	6.1–7.3
McGarr:				
28E, [1] 28F	0–14	0.2–0.6	0.12–0.19	6.1–7.3
	14–31	0.2–0.6	0.12–0.19	6.1–7.3
	31			

properties of soils—Continued

Salinity	Shrink-swell potential	Risk of corrosion		Erosion factors	
		Uncoated steel	Concrete	K	T
Mmhos/cm					
	Low	Moderate	Low	0.28	1
	Low	Moderate	Low	0.24	
	Low	Moderate	Low	0.10	1
	Low	Moderate	Low	0.10	
	Low	Moderate	Low	0.28	1
	Low	Moderate	Low	0.24	
	Low	Moderate	Low	0.28	5
<2	Low	High	Low	0.32	
	Low	Moderate	Low	0.20	5
<2	Low	High	Low	0.32	
	Moderate	Moderate	Low	0.32	4
<2	High	High	Low	0.20	
	Low	Moderate	Moderate	0.49	5
	Moderate	Moderate	Moderate	0.55	
	Low	Moderate	Low	0.10	2
	Low	Low	Low	0.10	
	Low	Moderate	Low	0.10	1
	Low	Low	Low	0.10	
	Moderate	Moderate	Low	0.24	2
<2	High	High	Low	0.17	
	Moderate	Moderate	Low	0.24	2
<2	High	High	Low	0.17	
	Low	Moderate	Low	0.17	1
<2	Low	Moderate	Low	0.24	
	Low	Moderate	Low	0.10	1
	Low	Low	Low	0.10	
	Low	Moderate	Low	0.37	2
<2	Moderate	Moderate	Low	0.37	

TABLE 13.—*Physical and chemical*

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction
	In	*In/hr*	*In/in*	*pH*
McGarr—continued:				
[1] 29F:				
McGarr part	0–14	0.2–0.6	0.12–0.19	6.1–7.3
	14–31	0.2–0.6	0.12–0.19	6.1–7.3
	31			
Anatone part	0–3	0.6–2.0	0.08–0.10	6.1–7.3
	3–11	0.6–2.0	0.09–0.12	6.1–7.3
	11			
Oxbow:				
30B	0–12	0.2–0.6	0.15–0.20	6.1–7.3
	12–27	0.06–0.2	0.10–0.14	6.6–8.4
	27			
Oxwall:				
31B, 32B	0–8	0.2–0.6	0.15–0.20	6.1–6.5
	8–13	0.06–0.2	0.10–0.14	6.6–7.3
	13			
Piersonte:				
[1] 33F:				
Piersonte part	0–10	0.6–2.0	0.10–0.13	6.6–7.3
	10–60	0.6–2.0	0.05–0.10	6.6–7.3
Logdell part	0–8	0.6–2.0	0.06–0.14	6.1–7.3
	8–60	>6.0	0.01–0.02	6.1–7.3
Laycock part	0–17	0.6–2.0	0.05–0.12	6.1–6.5
	17–60	>6.0	0.01–0.02	6.1–6.5
Powder:				
34	0–32	0.6–2.0	0.20–0.25	6.6–8.4
	32–60	0.6–2.0	0.18–0.25	7.4–8.4
Ricco:				
35	0–15	0.6–2.0	0.24–0.26	6.1–6.5
	15–72	0.06–0.2	0.16–0.21	6.6–7.3
Rock outcrop:				
[1] 36F:				
Rock outcrop part.				
Lemonex part	0–8	0.2–0.6	0.11–0.17	6.6–7.3
	8–27	0.06–0.2	0.09–0.15	6.6–7.3
	27			
Lithic Xerochrepts part	0–8			
	8			
Rockly:				
37D	0–4	0.6–2.0	0.06–0.11	6.1–7.3
	4–8	0.2–0.6	0.06–0.11	6.1–7.3
	8			
Ruddley:				
[1] 38E	0–8	0.6–2.0	0.15–0.18	6.1–6.5
	8–18	0.2–0.6	0.13–0.19	6.6–7.3
	18			
[1] 39E:				
Ruddley part	0–8	0.6–2.0	0.15–0.18	6.1–6.5
	8–18	0.2–0.6	0.13–0.19	6.6–7.3
	18			
Rock outcrop part.				
Lithic Xerochrepts part	0–8			
	8			

properties of soils—Continued

Salinity	Shrink-swell potential	Risk of corrosion		Erosion factors	
		Uncoated steel	Concrete	K	T
Mmhos/cm					
	Low	Moderate	Low	0.37	2
<2	Moderate	Moderate	Low	0.37	
	Low	Moderate	Low	0.20	1
	Low	Moderate	Low	0.20	
	Moderate	Moderate	Low	0.28	2
<2	High	High	Low	0.20	
	Moderate	Moderate	Low	0.28	1
<2	High	High	Low	0.20	
<2	Low	Low	Low	0.15	5
<2	Low	Low	Low	0.10	
	Low	Moderate	Low	0.10	1
	Low	Low	Low	0.10	
	Low	Moderate	Low	0.10	2
	Low	Low	Low	0.10	
<2	Low	High	Low	0.37	5
<2	Low	High	Low	0.37	
	Moderate	High	Low		
<2	Moderate	High	Low		
	Moderate	High	Low	0.24	2
<2	High	High	Low	0.17	
	Low	Moderate	Low	0.10	1
	Low	Moderate	Low	0.10	
	Low	Moderate	Low	0.28	1
	Moderate	Moderate	Low	0.28	
	Low	Moderate	Low	0.28	1
	Moderate	Moderate	Low	0.28	

TABLE 13.—*Physical and chemical*

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction
	In	*In/hr*	*In/in*	*pH*
Simas:				
40E	0–5	0.2–0.6	0.15–0.21	6.6–7.3
	5–21	0.06–0.2	0.09–0.16	7.9–8.4
	21–60	0.06–0.2	0.09–0.13	7.9–9.0
41E	0–5	0.2–0.6	0.10–0.16	6.6–7.3
	5–21	0.06–0.2	0.09–0.16	7.9–8.4
	21–60	0.06–0.2	0.09–0.13	7.9–9.0
[1] 42E:				
Simas part	0–5	0.2–0.6	0.10–0.16	6.6–7.3
	5–21	0.06–0.2	0.09–0.16	7.9–8.4
	21–60	0.06–0.2	0.09–0.13	7.9–9.0
Day part	0–43	<0.06	0.14–0.16	6.6–9.0
	43			
[1] 43F:				
Simas part	0–5	0.2–0.6	0.10–0.16	6.6–7.3
	5–21	0.06–0.2	0.09–0.16	7.9–8.4
	21–60	0.06–0.2	0.09–0.13	7.9–9.0
Badland part.				
[1] 44E:				
Simas part	0–5	0.2–0.6	0.10–0.16	6.6–7.3
	5–21	0.06–0.2	0.09–0.16	7.9–8.4
	21–60	0.06–0.2	0.09–0.13	7.9–9.0
Tub part	0–8	0.2–0.6	0.06–0.11	6.6–7.3
	8–23	0.06–0.2	0.12–0.14	7.4–7.8
	23–60	0.2–0.6	0.17–0.19	7.9–8.4
Snell:				
45E	0–10	0.6–2.0	0.08–0.11	6.6–7.3
	10–23	0.2–0.6	0.05–0.10	6.6–7.3
	23			
[1] 46E, [1] 46F:				
Snell part	0–10	0.6–2.0	0.08–0.11	6.6–7.3
	10–23	0.2–0.6	0.05–0.10	6.6–7.3
	23			
Anatone part	0–3	0.6–2.0	0.08–0.10	6.1–7.3
	3–11	0.6–2.0	0.09–0.12	6.1–7.3
	11			
Top:				
47E, 47F	0–5	0.6–2.0	0.19–0.21	6.1–7.3
	5–36	0.2–0.6	0.15–0.21	6.1–7.3
	36–45	0.6–2.0	0.16–0.21	6.1–7.3
	45			
Tub:				
48E, 48F	0–8	0.2–0.6	0.18–0.21	6.6–7.3
	8–23	0.06–0.2	0.12–0.14	7.4–7.8
	23–60	0.2–0.6	0.17–0.19	7.9–8.4
49D	0–8	0.2–0.6	0.17–0.19	6.6–7.3
	8–23	0.06–0.2	0.12–0.14	7.4–7.8
	23–60	0.2–0.6	0.17–0.19	7.9–8.4

properties of soils—Continued

Salinity	Shrink-swell potential	Risk of corrosion		Erosion factors	
		Uncoated steel	Concrete	K	T
Mmhos/cm					
	Moderate	High	Low	0.28	4
<2	High	High	Low	0.20	
<2	High	High	Low	0.20	
	Moderate	High	Low	0.20	4
<2	High	High	Low	0.20	
<4	High	High	Low	0.20	
	Moderate	High	Low	0.20	4
<2	High	High	Low	0.20	
<4	High	High	Low	0.20	
<2	High	High	Low	0.17	5
	Moderate	High	Low	0.20	4
<2	High	High	Low	0.20	
<4	High	High	Low	0.20	
	Moderate	High	Low	0.20	4
<2	High	High	Low	0.20	
<4	High	High	Low	0.20	
	Moderate	High	Low	0.20	2
<2	High	High	Low	0.20	
<2	High	High	Low	0.28	
	Low	Moderate	Low	0.10	2
<2	High	High	Low	0.10	
	Low	Moderate	Low	0.10	2
<2	High	High	Low	0.10	
	Low	Moderate	Low	0.20	1
	Low	Moderate	Low	0.20	
	Low	Moderate	Low	0.32	3
<2	High	High	Low	0.37	
<2	Moderate	Moderate	Low	0.32	
	Moderate	High	Low	0.37	2
<2	High	High	Low	0.20	
<2	High	High	Low	0.28	
	Moderate	High	Low	0.28	2
<2	High	High	Low	0.20	
<2	High	High	Low	0.28	

TABLE 13.—*Physical and chemical*

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction
	In	*In/hr*	*In/in*	*pH*
Ukiah:				
50B	0–6	0.06–0.2	0.16–0.18	6.6–7.3
	6–30	<0.06	0.09–0.14	6.6–7.3
	30			
51C	0–6	0.06–0.2	0.14–0.18	6.6–7.3
	6–30	<0.06	0.09–0.14	6.6–7.3
	30			
52E	0–6	0.06–0.2	0.12–0.18	6.6–7.3
	6–30	<0.06	0.09–0.14	6.6–7.3
	30			
Veazie:				
53	0–24	0.6–2.0	0.16–0.18	6.6–7.3
	24–60	>20	0.03–0.05	6.6–7.3
Venator:				
54E	0–5	0.6–2.0	0.06–0.14	6.1–7.3
	5–12	0.6–2.0	0.06–0.14	6.6–7.3
	12			
[1] 55F:				
Venator part	0–5	0.6–2.0	0.06–0.14	6.1–7.3
	5–12	0.6–2.0	0.06–0.14	6.6–7.3
	12			
Rock outcrop part.				
Waterbury:				
56E	0–4	0.06–0.2	0.09–0.17	6.6–7.3
	4–15	<0.06	0.04–0.10	6.6–7.3
	15			
Wrightman:				
[1] 57D:				
Wrightman part	0–25	0.6–2.0	0.15–0.21	6.1–7.3
	25			
Anatone part	0–3	0.6–2.0	0.08–0.10	6.1–7.3
	3–11	0.6–2.0	0.09–0.12	6.1–7.3
	11			

[1] This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and

heaving and low soil strength after thawing. Frost action is defined as freezing temperatures in the soil and movement of soil moisture into the freezing zone, which causes the formation of ice lenses. Texture, temperature, moisture content, porosity, permeability, and content of organic matter are the most important soil properties that affect frost action. It is assumed that the soil is not covered by insulating vegetation or snow and is not artificially drained. Silty and clayey soils that have a high water table in winter are most susceptible to frost action. Well drained very gravelly or sandy soils are the least susceptible.

Formation, Morphology, and Classification of the Soils

In this section, the factors that have affected the formation and composition of the soils in Grant County, Oregon, Central Part, are described, and some important morphological features are discussed. The last part of the section deals with the classification of the soils of the survey area.

Formation of Soils

Soil is a collection of natural earthy material consisting of organic matter, minerals, air, and water in which plants can grow. Soils differ in their appearance, composition, productivity, and management requirements in different localities or even within short distances in the same locality. The factors that cause soils to differ are the climate, parent material, plants and animals, relief, and time. The relative importance of each factor differs from place to place, but generally the interaction of all the factors determines the kind of soil that forms in any given place.

properties of soils—Continued

Salinity	Shrink-swell potential	Risk of corrosion		Erosion factors	
		Uncoated steel	Concrete	K	T
Mmhos/cm					
<2	Moderate High	High High	Low Low	0.28 0.28	2
<2	Moderate High	High High	Low Low	0.20 0.28	2
<2	Moderate High	High High	Low Low	0.17 0.28	2
<2	Low Low	Moderate Moderate	Low Low	0.43 0.10	2
	Low Low	Moderate Moderate	Low Low	0.20 0.20	1
	Low Low	Moderate Moderate	Low Low	0.20 0.20	1
<2	Moderate High	High High	Low Low	0.28 0.17	1
	Low	Moderate	Low	0.37	2
	Low Low	Moderate Moderate	Low Low	0.20 0.20	1

behavior of the whole mapping unit.

The influence of each of the five soil forming factors on the soils of Grant County, Oregon, Central Part, are discussed in the paragraphs that follow.

Climate

The climate is semiarid to subhumid, and most of the annual precipitation falls between October and June. There is a pronounced dry season during the summer months.

The effects of climate are expressed in the kinds and amount of vegetation. In this survey area the temperature in winter is cold enough that soils are frozen for long periods. During this time many processes of soil formation are stopped. Average annual air temperature is normally 45° to 52°F at elevations of about 2,100 to about 3,500 feet, and 40° to 45°F at 3,500 to 5,500 feet. The upper few inches of the soil are frozen for some period during winter, and daily freezing and thawing are common on south facing slopes. In summer, temperatures range from warm at the lower elevations to cool at the higher elevations.

The total precipitation and season of distribution are such that most soils become thoroughly dry in some part of the solum for at least 60 days in most years. The average annual precipitation is normally 10 to 20 inches in the grassland areas and 17 to 30 inches in the conifer forested areas at higher elevations. In summer precipitation is spotty and scant, and it is often lost to evaporation. Rainfall is insufficient to leach the soils strongly, but the upper few inches of many virgin soils are neutral to slightly acid. The soils generally are leached to a greater depth than soils that formed in regions where more of the rainfall occurs in summer.

Parent material

The soils formed in material weathered from bedrock and in colluvium on sloping to steep uplands

TABLE 14.—*Soil and*

[Absence of an entry indicates the feature is not

Soil name and map symbol	Hydrologic group	Flooding		High water table	
		Frequency	Months	Depth	Kind
				Ft	
Alding:					
[1] 1F:					
Alding part	D	None		>6.0	
Rock outcrop part					
Lithic Xerochrepts part	D	None		>6.0	
Anatone:					
[1] 2D:					
Anatone part	D	None		>6.0	
Wrightman part	C	None		>6.0	
Balder:					
3C, 4F	C	None		>6.0	
Boyce:					
5	B/D	Occasional	Dec.-Apr.	0.5–1.0	Apparent
Courtrock:					
6B	B	None		>6.0	
Daxty:					
7E	B	None		>6.0	
[1] 8E:					
Daxty part	B	None		>6.0	
Rock outcrop part					
Lithic Xerochrepts part	D	None		>6.0	
Dayville:					
9	C	Occasional	Dec.-Apr.	2.0–3.0	Apparent
Dumps:					
10					
Fopiano:					
11C, 11E	D	None		>6.0	
Grell:					
12E, 13E	D	None		>6.0	
Gwin:					
[1] 14E, [1] 14F:					
Gwin part	D	None		>6.0	
Rockly part	D	None		>6.0	
[1] 15F:					
Gwin part	D	None		>6.0	
Rock outcrop part					
Hack:					
16A, 16B, 16C, 17C, [1] 18D	B	None		>6.0	
Hankins:					
19E, 20E	C	None		>6.0	
Helter:					
21C, 21E, 21F	B	None		>6.0	
Laycock:					
[1] 22E, [1] 23E, [1] 23F:					
Laycock part	B	None		>6.0	
Logdell part	B	None		>6.0	
Lemonex:					
24E	C	None		>6.0	
[1] 25E:					
Lemonex part	C	None		>6.0	
Rock outcrop part					
Lithic Xerochrepts part	D	None		>6.0	

water features

a concern. The symbol > means greater than]

High water table—Cont'd	Bedrock		Cemented pan		Potential frost action
Months	Depth	Hardness	Depth	Hardness	
	In		*In*		
	10–20	Rippable			Moderate.
	3–15	Hard			
	10–20	Hard			Moderate.
	20–40	Hard			Moderate.
	10–20	Rippable			Moderate.
Mar.-Jul.	>60				High.
	>60				Moderate.
	20–40	Rippable			Moderate.
	20–40	Rippable			Moderate.
	3–15	Hard			
Mar.-Jul.	>60				High.
	10–20	Rippable			Moderate.
	10–20	Rippable			Moderate.
	10–20	Hard			Moderate.
	5–12	Hard			Moderate.
	10–20	Hard			Moderate.
	>60				Moderate.
	>60				Moderate.
	>60				High.
	14–20	Rippable			Moderate.
	4–14	Rippable			Low.
	20–40	Hard			Moderate.
	20–40	Hard			Moderate.
	3–15	Hard			

TABLE 14.—*Soil and*

Soil name and map symbol	Hydrologic group	Flooding		High water table	
		Frequency	Months	Depth	Kind
				Ft	
Lickskillet:					
[1] 26F:					
Lickskillet part	D	None		>6.0	
Rock outcrop part					
Logdell:					
27F	B	None		>6.0	
McGarr:					
28E, [1] 28F	C	None		>6.0	
[1] 29F:					
McGarr part	C	None		>6.0	
Anatone part	D	None		>6.0	
Oxbow:					
30B	C	None		>6.0	
Oxwall:					
31B, 32B	D	None		>6.0	
Piersonte:					
[1] 33F:					
Piersonte part	B	None		>6.0	
Logdell part	B	None		>6.0	
Laycock part	B	None		>6.0	
Powder:					
34	B	Common	Dec.-Apr.	>6.0	
Ricco:					
35	D	Occasional	Dec.-Apr.	0.5–1.0	Apparent
Rock outcrop:					
[1] 36F:					
Rock outcrop part					
Lemonex part	C	None		>6.0	
Lithic Xerochrepts part	D	None		>6.0	
Rockly:					
37D	D	None		>6.0	
Ruddley:					
[1] 38E	D	None		>6.0	
[1] 39E:					
Ruddley part	D	None		>6.0	
Rock outcrop part					
Lithic Xerochrepts part	D	None		>6.0	
Simas:					
40E, 41E	C	None		>6.0	
[1] 42E:					
Simas part	C	None		>6.0	
Day part	D	None		>6.0	
[1] 43F:					
Simas part	C	None		>6.0	
Badland part					
[1] 44E:					
Simas part	C	None		>6.0	
Tub part	C	None		>6.0	
Snell:					
45E	C	None		>6.0	
[1] 46E, [1] 46F:					
Snell part	C	None		>6.0	
Anatone part	D	None		>6.0	

water features—Continued

High water table—Cont'd	Bedrock		Cemented pan		Potential frost action
Months	Depth	Hardness	Depth	Hardness	
	In		*In*		
	12–20	Hard			Moderate.
	4–14	Rippable			Low.
	20–40	Hard			Moderate.
	20–40	Hard			Moderate.
	10–20	Hard			Moderate.
	>60		20–40	Rippable	Moderate.
	>60		10–20	Rippable	Moderate.
	>60				Moderate.
	4–14	Rippable			Low.
	14–20	Rippable			Moderate.
	>60				High.
Mar.-Jul.	>60				High.
	20–40	Hard			Moderate.
	3–15	Hard			
	5–12	Hard			Moderate.
	12–20	Rippable			Moderate.
	12–20	Rippable			Moderate.
	3–15	Hard			
	>60				Moderate.
	>60				Moderate.
	>60				Moderate.
	>60				Moderate.
	>40	Rippable			Moderate.
	20–40	Hard			Moderate.
	20–40	Hard			Moderate.
	10–20	Hard			Moderate.

TABLE 14.—*Soil and*

Soil name and map symbol	Hydrologic group	Flooding		High water table	
		Frequency	Months	Depth	Kind
				Ft	
Top:					
47E, 47F	C	None		>6.0	
48E, 49F, 49D	C	None		>6.0	
Ukiah:					
50B, 51C, 52E	C	None		>6.0	
Veazie:					
53	B	Frequent	Dec.-Apr.	>6.0	
Venator:					
54E	C	None		>6.0	
[1] 55F:					
Venator part	C	None		>6.0	
Rock outcrop part					
Waterbury:					
56E	D	None		>6.0	
Wrightman:					
[1] 57D:					
Wrightman part	C	None		>6.0	
Anatone part	D	None		>6.0	

[1] This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and

and plateaus; in old clayey unconsolidated material; in recent material transported by water and laid down as unconsolidated deposits of clay, silt, sand, and gravel; in volcanic ash from geologically recent vulcanism; and in silty and loamy material transported by wind.

The size of particles, mineralogy, and thickness of the parent material have influenced the nature of the soils. Some soil characteristics are inherited directly from the parent material. For example, soils that formed mainly in residuum from hard bedrock generally are shallow and stony and soils that formed in old fine, waterlaid, unconsolidated material generally are deep and clayey.

The oldest exposed geologic formations in the survey area are those of the Permian Period (*8, 9*). They are only minor in extent, and most of them have been covered up by succeeding formations. The formations are in the Little Canyon Mountain area and consist mainly of metavolcanic rock. These rocks weather slowly and result in shallow gravelly soils. Alding soils formed in residuum and colluvium weathered from this material.

The next oldest geologic formations are those of the Triassic Period. They are extensive in the Canyon Creek area and consist mainly of serpentine and shale. Grell soils formed mainly in residuum and colluvium from the serpentine. Laycock, Logdell, Piersonte, and Venator soils formed in residuum and colluvium from the shale.

The third oldest exposed geologic formations are those of the Tertiary Period. These consist of Columbia River Basalt and the John Day Formation. The Columbia River Basalt occurs above the John Day Formation. The major drainageways have eroded through the hard basalt and into the soft John Day Formation which is composed dominantly of fine, unconsolidated, waterlaid material that erodes rapidly. The drainages are deeply entrenched with steep canyon walls, especially in the western part of the survey area. Columbia River Basalt occurs in the Rudio Mountain area north of Dayville in the northern part of the survey area. Lickskillet, Gwin, Snell, and Anatone soils formed mostly in residuum and colluvium from the basalt. The John Day Formation underlies the uplands east of the John Day River north of Picture Gorge in the northwestern part of the survey area. Simas, Tub, and Day soils formed in residuum from the John Day Formation.

More recent geologic formations of Quaternary age were deposited over the older formations in much of the area below 4,000 feet elevation along the main fork of the John Day River between Prairie City and Picture Gorge. Oxbow and Oxwall soils formed in these materials.

During recent geologic times, a thin mantle of loess was laid down over much of the survey area. This has modified the surface layer of many of the upland soils. Relatively thick deposits of volcanic ash were laid down in the Rudio Mountain area. Mostly as a result of preferential erosion, this deposit is thickest on north facing slopes.

Recent alluvium occurs along the principal tributaries. It consists of sands, gravel, loamy, and clayey material. Soils in the Veazie, Boyce, Powder, and Ricco series formed on the flood plain. Courtrock and Hack soils formed on alluvial fans and low terraces.

Plants and animals

Natural vegetation in well drained areas throughout

water features—Continued

High water table—Cont'd	Bedrock		Cemented pan		Potential frost action
Months	Depth	Hardness	Depth	Hardness	
	In		*In*		
	40–60	Hard			Moderate.
	>40	Rippable			Moderate.
	20–40	Rippable			Moderate.
	>60				Moderate.
	10–20	Rippable			Moderate.
	10–20	Rippable			Moderate.
	12–20	Hard			Moderate.
	20–40	Hard			Moderate.
	10–20	Hard			Moderate.

behavior of the whole mapping unit.

the 10 to 16 inch precipitation zone is mainly bluebunch wheatgrass, Sandberg bluegrass, Idaho fescue, big sagebrush, and bitterbrush. In these areas soils have a surface layer about 10 to 20 inches thick, and they are more than 1 percent organic matter. As precipitation increases to more than 16 inches and elevation increases to more than 4,200 feet, coniferous forests replace the grass and shrub vegetation. The depth and amount of leaching increase as the bunchgrasses give way to trees.

Soils that are not well drained have native plants that differ from the types common on well drained soils. Grasses, sedges, and rushes grow in various combinations on the flood plains of streams. This vegetation supplies an abundance of organic matter, and soils in these areas commonly have a thick, dark colored surface layer.

Animals and insects that burrow in the soil also influence the kinds of soil that form, but they probably have less influence than plants on the soils of this survey area. Badgers are commonly active in sandy or loamy soils that are relatively free of stones.

Relief

Aspect, or the direction a slope faces, is one of the most important features of relief that has affected soil formation in this survey area. Soils that have south facing slopes are warmer and drier than those that have north facing slopes. They also have less natural vegetation, have a lower content of organic matter, and have retained a thinner mantle of loess and volcanic ash against erosion.

Slope is another important feature of relief as a soil forming factor. Steep soils commonly have thinner and less distinct soil horizons than gently sloping soils. Also, they have more erosion, and they retain less water.

Most soils in the survey area are well drained. Wet soils are only on flood plains.

Time

The length of time that soil parent material has been subjected to weathering plays a significant role in soil formation. If other factors are equal, younger soils have less horizon differentiation than older soils. For example, Powder and Veazie soils formed in recent alluvium, and although leaching has been active, no B horizon has formed. Lickskillet and Gwin soils formed over a longer period of time and have a distinct B horizon.

Morphology of the Soils

The differentiation of soil horizons is the result of one or more of the following: accumulation of organic matter in the A horizon; accumulation of silicate clay in the B horizon; retention of appreciable amounts of Ca, K, and Mg to give high base saturation; accumulation or retention of calcium carbonate in lower horizons; and cementation of soil by alkali-soluble materials to form a hardpan in well drained soils. Oxbow soils show the influence of all five of these processes.

Organic matter has accumulated in the surface layer to form an A1 horizon in all of the soils in the survey area. The quantities are lowest in Lickskillet and Simas soils and highest in Boyce and Ricco soils.

Simas, Oxbow, Fopiano, Alding, Gwin, Hankins, Lemonex, Oxwall, Ruddley, Snell, Top, Tub, Ukiah, and Waterbury soils have accumulated clay to form an

argillic horizon. This subsurface horizon results from the translocation of silicate clay minerals, a greater formation of clay from primary minerals within the B horizon than within other horizons, and buried layers of older soils.

Nearly all soils in the survey area have moderate to high base saturation. Simas soils probably have the highest, and Helter soils have the lowest.

There is visible evidence of leaching of carbonates and salts in most soils in the survey area. Simas soils contain calcium carbonate below the surface horizon and have been leached the least. Helter soils are free of carbonates and have been leached the most.

Sodium has accumulated in a few small spots in Hack soils. The accumulation of exchangeable sodium is a minor concern in soils of this survey area.

Classification

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us to understand their behavior and their response to management. First through classification and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The narrow categories of classification, such as those used in detailed soil surveys, allow us to organize and apply knowledge about soils in managing farms, fields, and woodlands; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison of large areas such as countries and continents.

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965. Readers interested in further details about the system should refer to the latest literature (*12, 13*).

The classification has six categories. Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. In this system the differentiae used as a basis for classification are soil properties that can be observed in the field or those that can be inferred either from other properties that are observable in the field, or from the combined data of soil science and other disciplines. The properties selected for the higher categories are the result of soil genesis or of factors that affect soil genesis. In table 15 the soil series of Grant County, Oregon, Central Part, are placed in categories of the current system. Categories of this system are defined briefly in the following paragraphs.

TABLE 15.—*Classification of the soils*

Soil name	Family or higher taxonomic class
Alding	Clayey, montmorillonitic, frigid Lithic Ultic Argixerolls.
Anatone	Loamy-skeletal, mixed, frigid Lithic Haploxerolls.
Balder	Loamy, mixed, mesic, shallow Typic Haploxerolls.
Boyce	Fine-silty over sandy or sandy-skeletal, mixed, mesic Cumulic Haplaquolls.
Courtrock	Coarse-loamy, mixed, mesic Calciorthidic Haploxerolls.
Daxty	Loamy-skeletal, mixed, frigid Typic Xerochrepts.
Day	Very-fine, montmorillonitic, mesic Typic Chromoxererts.
Dayville	Fine-silty over sandy or sandy-skeletal, mixed, mesic Cumulic Haplaquolls.
Fopiano	Clayey, montmorillonitic, frigid, shallow Typic Argixerolls.
Grell	Loamy-skeletal, serpentinitic, mesic Lithic Haploxerolls.
Gwin	Loamy-skeletal, mixed, mesic Lithic Argixerolls.
Hack	Fine-loamy, mixed, mesic Calcic Argixerolls.
Hankins	Fine, montmorillonitic, frigid Ultic Palexerolls.
Helter	Medial over loamy, mixed Entic Cryandepts.
Laycock	Loamy-skeletal over fragmental, mixed, frigid Ultic Haploxerolls.
Lemonex	Fine, montmorillonitic, frigid Ultic Argixerolls.
Lickskillet	Loamy-skeletal, mixed, mesic Lithic Haploxerolls.
Lithic Xerochrepts	Lithic Xerochrepts.
Logdell	Fragmental, mixed, frigid Ultic Haploxerolls.
McGarr	Fine-loamy, mixed, frigid, Pachic Ultic Haploxerolls.
Oxbow	Fine, montmorillonitic, mesic Typic Durixerolls.
Oxwall	Clayey, montmorillonitic, mesic, shallow Typic Durixerolls.
Piersonte	Loamy-skeletal, mixed, frigid Pachic Ultic Haploxerolls.
Powder	Coarse-silty, mixed, mesic Cumulic Haploxerolls.
Ricco	Fine, montmorillonitic, mesic Fluvaquentic Haplaquolls.
Rockly	Loamy-skeletal, mixed, mesic Lithic Haploxerolls.
Ruddley	Loamy, mixed, frigid, shallow Ultic Argixerolls.
Simas	Fine, montmorillonitic, mesic Aridic Palexerolls.
Snell	Clayey-skeletal, montmorillonitic, frigid Pachic Argixerolls.
Top	Fine, montmorillonitic, frigid Pachic Ultic Argixerolls.
Tub	Fine, montmorillonitic, mesic Calcic Pachic Argixerolls.
Ukiah	Fine, montmorillonitic, mesic Vertic Argixerolls.
Veazie	Coarse-loamy over sandy or sandy-skeletal, mixed, mesic Cumulic Haploxerolls.
Venator	Loamy-skeletal, mixed, mesic Lithic Haploxerolls.
Waterbury	Clayey-skeletal, montmorillonitic, mesic Lithic Argixerolls.
Wrightman	Fine-loamy, mixed, frigid Pachic Haploxerolls.

ORDER. Ten soil orders are recognized. The differentiae for the orders are based on the kind and degree of the dominant sets of soil-forming processes that have gone on. Each order is named with a word of three or four syllables ending in *sol.* An example is Mollisol.

SUBORDER. Each order is divided into suborders that are based primarily on properties that influence soil genesis and that are important to plant growth, or were selected to reflect what seemed to be the most important variables within the orders. The names of suborders have exactly two syllables. The last syllable indicates the order. An example is Xeroll (*Xer,* meaning dry, plus *oll,* from Mollisol).

GREAT GROUP. Soil suborders are separated into great groups on the basis of close similarities in kind, arrangement, and degree of expression of pedogenic horizons, soil moisture and temperature regimes, and in base status. The names of great groups have three or four syllables and end with the name of a suborder. A prefix added to the name suggests something about the properties of the soil. An example is Haploxeroll (*Hapl,* meaning minimum horizon differentiation, plus *xeroll,* the suborder of Mollisols that have a xeric moisture regime).

SUBGROUP. Great groups are divided into three kinds of subgroups: the central (typic) concept of the great groups (not necessarily the most extensive subgroup); the intergrades, or transitional forms to other orders, suborders, or great groups; and extragrade subgroups that have some properties that are representative of the great groups but that do not indicate transitions to any other known kind of soil. The names of subgroups are derived by placing one or more adjectives before the name of the great group. The adjective Typic is used for the subgroup that is thought to typify the great group. An example is Typic Haploxeroll.

FAMILY. Soil families group soils within a subgroup that have similar enough physical and chemical properties that responses to management are nearly the same for comparable phases. Among the properties considered in horizons of major biological activity below plow depth are particle-size distribution, mineralogy, temperature regime, thickness of the soil penetrable by roots, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup and a series of adjectives. The adjectives are the class names for particle size, mineralogy, reaction, and so on, that are used as family differentiae. An example is Typic Haploxeroll, loamy, mixed, mesic, shallow.

SERIES. The series consists of a group of soils that formed in a particular kind of parent material and have horizons that, except for texture of the surface soil, are similar in differentiating characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineralogical and chemical composition. The names are place names taken from the area where the soil is first defined. An example is Balder series.

General Nature of the Area

This section provides general information about the relief and drainage, climate, transportation, and water supply of Grant County, Oregon, Central Part.

Relief and Drainage

Grant County, Oregon, Central Part, occupies an area that extends from a few miles north to a few miles south of the main fork of the John Day River and from the Grant-Wheeler county line in the west to within a few miles of the Grant-Baker county line in the east. The soil survey area boundary coincides with the National Forest boundary, for the most part, on the northern, eastern, and southern sides. The area is hilly and mountainous except for the narrow flood plain and old terraces south and southwest of Prairie City. It is drained entirely by the Main Fork of the John Day River. Timbered, mountainous areas along the northern, eastern, and southern boundaries are 2,500 to 3,400 feet above the flood plain of the river.

The survey area is characterized by extremely faulted and folded complex mountain ranges in the southern part. In the northern part, basalt flows are underlain by softer waterlaid clayey material. Many basalt rims and escarpments are in the northwestern part of the survey area.

Elevation is about 2,100 feet at the lowest point in the survey area to about 5,500 feet at the highest point.

Patterned ground, locally called biscuit scabland, makes up about 2,700 acres or about 0.6 percent of the survey area. Patterned ground is the general term applied to biscuits or mounds, stone nets, and stone stripes that form distinct patterns on the ground surface (*12*). The patterned ground in the survey area probably resulted from thawing of ice wedges followed by erosion during a former period of "frost climate" (*5*).

The main fork of the John Day River drains the entire survey area except for a few sections in the Rudio Mountain area, which drains into the north fork of the John Day River. Canyon Creek and the south fork of the John Day River are major tributaries that join the main fork at John Day and Dayville, respectively. Both have the major part of their drainage areas outside the survey area.

The major streams are perennial, but late in summer the flow is insufficient to provide adequate irrigation water for the areas that have more recent water rights. The stability of the streambeds is generally low. On the larger streams, lateral cutting is common, especially during major floods. Many of the smaller drainageways are cutting vertically. They generally have gradients of more than 3 percent. Turbidity occurs in all streams during periods of rapid runoff. Cloudbursts are common during the summer, mainly in the Dayville area. These sudden very intense rainstorms are usually limited to small areas but move vast amounts of debris and cause high turbidity in the main drainages, occasionally causing heavy fish loss.

Transportation

The airport at John Day has adequate facilities for small commercial passenger and private planes. No scheduled passenger service is available.

The nearest railroad is in Burns, about 70 miles

south. A privately owned railroad goes from Burns to Seneca, about 20 miles south of John Day. Most freight is shipped from Portland or Ontario via U.S. Highway 25. U.S. Highway 26 passes through the center of the survey area from east to west through the towns of Prairie City, John Day, Mt. Vernon, and Dayville. It leaves the survey area near Picture Gorge near the western boundary. U.S. Highway 395 passes through the eastern part of the survey area from north to south through the towns of Canyon City, John Day, and Mt. Vernon. Oregon Highway 19 follows the main fork of the John Day River from its junction with U.S. Highway 26 at Picture Gorge and leaves the survey area at the northern boundary. Most other roads are county roads. A privately owned road permits travel from Dayville up Franks Creek to the Rudio Mountain area.

Water Supply

Water supplies for Grant County, Oregon, Central Part, depend on several sources. Irrigation water is obtained by diversion from streams. No major reservoirs for water storage for irrigation exist in the survey area. Municipal water is obtained from deep wells or from springs. Water for domestic use in rural areas is obtained from springs or shallow wells for the most part. Stock water is obtained from springs, ponds, and creeks (fig. 10).

Climate

Summer in Grant County is warm or hot in most valleys and much cooler in the mountains. Winters in the mountains are cold. Valleys are colder than the lower slopes of adjacent mountains because of cold air drainage. Precipitation occurs in the mountains throughout the year, and a deep snowpack accumulates during winter. Snowmelt generally supplies much more water than can be used for farming. In summer precipitation falls as showers in the valley, and some thunderstorms occur. In winter the ground is covered with snow much of the time. Chinook winds, which blow downslope and are warm and dry, often melt and evaporate the snow.

Table 16 gives data on temperature and precipitation for the survey area, as recorded at Dayville, Oregon, for the period 1951 to 1973. Table 17 shows probable

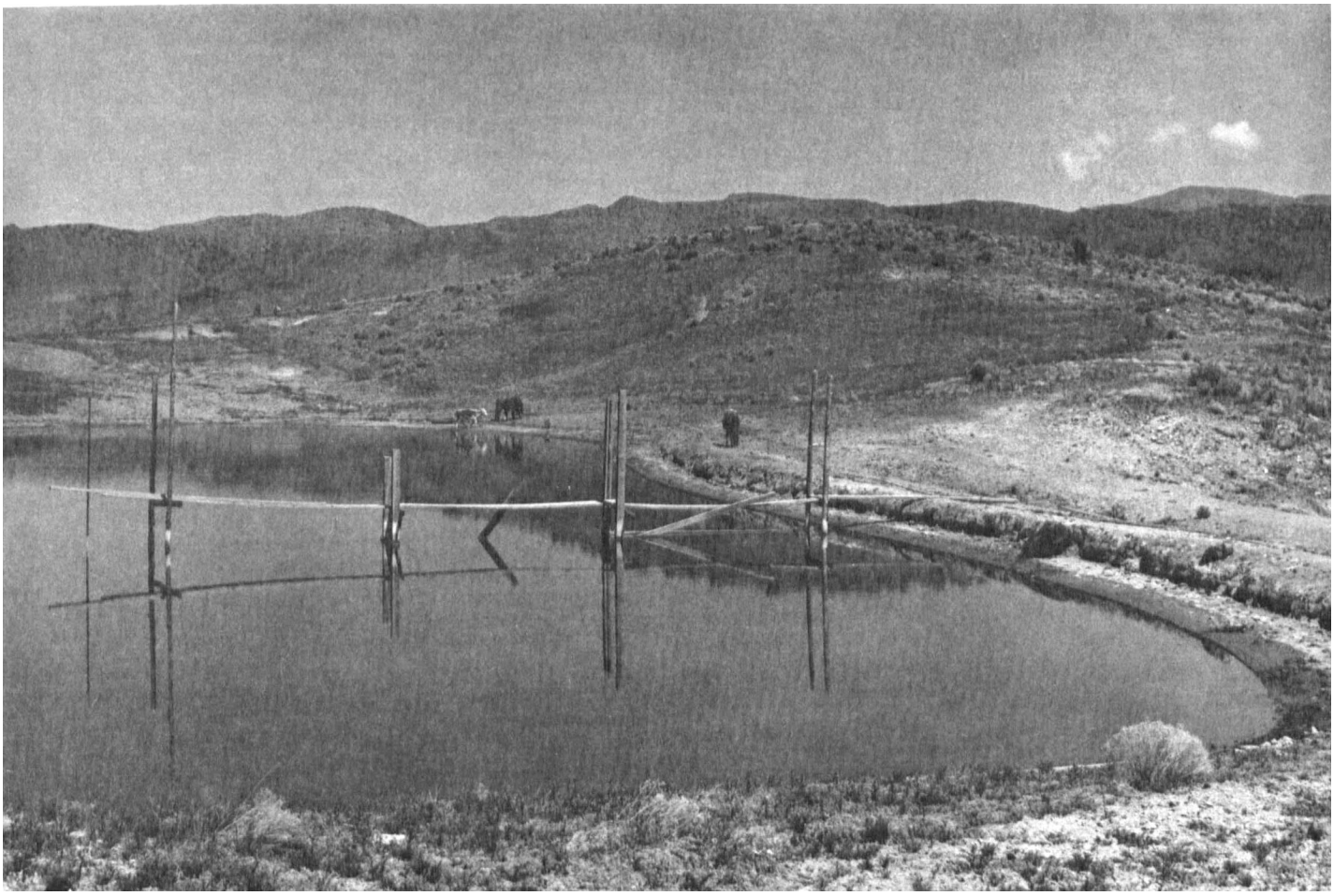

Figure 10.—Stock pond on Simas clay loam, 8 to 30 percent south slopes.

dates of the first freeze in fall and the last freeze in spring. Table 18 provides data on length of the growing season.

In winter the average temperature is 36.5° F, and the average daily minimum is 26.5°. The lowest temperature on record, −28°, occurred at Dayville on January 22, 1962. In summer the average temperature is 66.8°, and the average daily maximum is 85.8°. The highest temperature, 108°, was recorded on August 4, 1961.

"Growing degree days," shown in table 16, are equivalent to heat units. Beginning in spring, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (40°). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

Of the total annual precipitation, 5.27 inches, or 44 percent, generally falls from April through September, which includes the growing season of most crops. In 2 years in 10, the April to September rainfall is less than 4.01 inches. The heaviest 1-day rainfall during the period of record was 1.50 inches at Dayville on August 9, 1952. About 14 thunderstorms occur each year; 9 of these occur in summer.

Average seasonal snowfall is 15 inches. The greatest snow depth at any one time during the period of record was 9 inches. An average of six days have at least 1 inch of snow, but the number of days varies greatly from year to year.

The average relative humidity in midafternoon in spring is less than 38 percent; during the rest of the year it is about 43 percent. Humidity is higher at night in all seasons, and the average at dawn is about 60 percent.

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Glossary

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim. An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	More than 9

Base saturation. The degree to which material having base exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the exchange capacity.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the bases of steep slopes.

Compressible. Excessive decrease in volume of soft soil under load.

Conglomerate. Rock composed of gravel and rounded stones cemented together by clay, lime, iron oxide, or silica.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together itno a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Crop year. The year in which a crop is harvested; in contrast to the fallow year when no crop is grown and the soil accumulates moisture for the crop year.

Depth to rock. Bedrock at a depth that adversely affects the specified use.

Diagnostic horizon (soil). A soil horizon that has combinations of specific soil characteristics indicative of a certain class of soil. Those that occur at the surface are called epipedons; those below the surface, diagnostic subsurface horizons.

Drainage class (natural). Refers to the frequently and duration

TABLE 16.—*Temperature and*

Month	Temperature				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have—	
				Maximum temperature higher than—	Minimum temperature lower than—
	°F	°F	°F	°F	°F
January	43.8	25.2	34.5	63	− 7
February	50.6	28.1	39.4	71	6
March	36.0	28.8	42.4	78	12
April	64.1	33.0	48.5	88	18
May	72.8	40.0	56.4	94	25
June	80.1	46.1	63.1	99	32
July	89.9	49.1	69.5	103	36
August	87.5	47.9	67.7	101	35
September	79.4	40.7	60.1	97	25
October	67.2	34.1	50.7	89	17
November	52.6	29.7	41.1	71	7
December	44.8	26.2	35.5	62	0
Year	65.7	35.7	50.7	104	− 12

[1] Recorded in the period 1951–73 at Dayville, Oregon.

of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients, as for example in "hillpeats" and "climatic moors."

Dryfarming. Crops are produced without irrigation. Some tillage is required in a subhumid or semiarid region. Dryfarming usually involves using periods of fallow that allow time for moisture to accumulate in the soil for future cultivated crops.

Duripan. A subsurface horizon that is cemented by silica.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Erosion. The wearing away of the land surface by running water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes a bare surface.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Frost action. Freezing and thawing of soil moisture. Frost action can damage structures and plant roots.

Frost-free season. The length of time between the average dates of the last occurrence in spring and the first occurrence in fall of a given temperature at or below freezing.

precipitation data [1]

Temperature—Continued	Precipitation				
Average number of growing degree days [2]	Average	2 years in 10 will have—		Average number of days with 0.10 inch or more	Average snowfall
		Less than—	More than—		
	In	*In*	*In*		*In*
76	1.42	0.77	1.95	5	4.9
94	.87	.35	1.29	3	2.6
118	1.01	.47	1.44	4	2.1
265	.98	.43	1.42	3	.9
508	1.72	.89	2.38	5	.0
693	1.21	.37	1.86	4	.0
915	.36	.00	.62	1	.0
859	.51	.07	.84	1	.0
603	.50	.08	.82	2	.0
332	.87	.31	1.33	3	.3
112	1.22	.53	1.78	4	.8
30	1.41	.73	1.95	6	3.6
4,605	12.08	9.96	14.10	41	15.2

[2] A growing degree day is an index of the amount of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (40° F).

For this survey, the frost-free season was calculated for temperatures of 32° F.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. The major horizons of mineral soil are as follows:

O horizon.—An organic layer, fresh and decaying plant residue, at the surface of a mineral soil.

A horizon.—The mineral horizon, formed or forming at or near the surface, in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon most of which was originally part of a B horizon.

A2 horizon.—A mineral horizon, mainly a residual concentration of sand and silt high in content of resistant minerals as a result of the loss of silicate clay, iron, aluminum, or a combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or a combination of these; (2) by prismatic or blocky structure; (3) by redder or browner colors than those in the A horizon; or (4) by a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that from which the solum is presumed to have formed. If the material is known to differ from that in the solum the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock com-

TABLE 17.—*Freeze dates in spring and fall*

Probability	Minimum temperature [1]		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than	May 1	May 24	June 15
2 years in 10 later than	April 26	May 19	June 8
5 years in 10 later than	April 16	May 9	May 25
First freezing temperature in fall:			
1 year in 10 earlier than	September 26	September 13	August 31
2 years in 10 earlier than	October 2	September 18	September 5
5 years in 10 earlier than	October 14	September 27	September 15

[1] Recorded in the period 1951–73 at Dayville, Oregon.

TABLE 18.—*Growing season length*

Probability	Daily minimum temperature during growing season [1]		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	*Days*	*Days*
9 Years in 10	155	117	83
8 Years in 10	164	125	93
5 Years in 10	180	141	112
2 Years in 10	197	156	131
1 Year in 10	205	164	141

[1] Recorded in the period 1951–73 at Dayville, Oregon.

monly underlies a C horizon, but can be directly below an A or a B horizon.

Illuviation. The accumulation of material in a soil horizon by deposits of suspended material and organic matter that have been removed from the horizon above. The B horizon is called an illuvial horizon since part of the fine clay in the B horizon, or subsoil, of many soils has moved downward from the A horizon.

Large stones. Rock fragments 10 inches (25 centimeters) or more across. Large stones adversely affect the specified use.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. Inadequate strength for supporting loads.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—few, common, and many; size—fine, medium, and coarse; and contrast—faint, distinct, and prominent. The size measurements are of the diameter along the greatest dimension. Fine indicates less than 5 millimeters (about 0.2 inch); medium, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and coarse, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three single variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Nutrient, plant. Any element taken in by a plant, essential to its growth, and used by it in the production of food and tissue. Plant nutrients are nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, zinc, and perhaps other elements obtained from the soil; and carbon, hydrogen, and oxygen obtained largely from the air and water.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Percs slowly. The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality that enables the soil to transmit water or air, measured as the number of inches per hour that water moves through the soil. Terms describing permeability are very slow (less than 0.06 inch), slow (0.06 to 0.20 inch), moderately slow (0.2 to 0.6 inch), moderate (0.6 to 2.0 inches), moderately rapid (2.0 to 6.0 inches), rapid (6.0 to 20 inches), and very rapid (more than 20 inches).

Piping. Formation by moving water of subsurface tunnels or pipelike cavities.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Rooting depth. Shallow root zone. The soil is shallow over a layer that greatly restricts roots. See Root zone.

Runoff. The precipitation discharged in stream channels from a drainage area. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage. The rapid movement of water through the soil. Seepage adversely affects the specified use.

Shearing. A distortion, strain, or failure producing a change in form, usually without change in volume, in which parallel layers of a body are displaced in the direction of their line of contact.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Small stones. Rock fragments 3 to 10 inches (7.5 to 25 centimeters) in diameter. Small stones adversely affect the specified use.

Soil depth. Refers to the distance from the surface of the soil to the underlying bedrock, hardpan, or other restrictive layer and it includes the root penetration of common plants. The depth classes used in this survey are: shallow, 4 to 20 inches; moderately deep, 20 to 40 inches; deep, over 40 inches.

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in mature soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristics of the soil are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates that are separated from adjoining aggregates. The principal forms of soil structure are—platy (laminated), prismatic (vertical axis of aggregates longer than horizontal), columnar (prisms with rounded tops), blocky (angular or subangular), and granu-

lar. Structureless soils are either single grained (each grain by itself, as in dune sand) or massive (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Thin layer. Otherwise suitable soil material too thin for the specified use.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Water-supplying capacity. The amount of water stored in the soil at the beginning of plant growth in the spring and the amount of rainfall, not in excess of evapotranspiration, that is added during the growing season.

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and the description of the soil series to which the mapping unit belongs. In referring to a capability unit, a range site, a woodland group, or a wildlife group, read the introduction to the section it is in for general information about its management.

Map symbol	Mapping unit	Page	Capability unit Symbol	Capability unit Page	Range site Name	Woodland group Number	Wildlife group Number
1F	Alding-Rock outcrop complex, 30 to 70 percent slopes	6	VIIs	38		---	--
	Alding soil	--	-------	--		5d1	5
	Rock outcrop	--	-------	--		---	--
	Lithic Xerochrepts	--	-------	--	Mahogany Rockland	---	5
2D	Anatone-Wrightman complex, 3 to 25 percent slopes	6	VIIs	38		---	4
	Anatone soil	--	-------	--	Scabland	---	--
	Wrightman soil	--	-------	--	Shrubby Rolling Hills	---	--
3C	Balder stony loam, 5 to 15 percent slopes	7	VIe	37	Rolling Hills	---	4
4F	Balder very stony loam, 15 to 55 percent slopes	7	VIIs	38	South Exposure	---	4
5	Boyce silty clay loam	8	IVw-1 Irrigated	37		---	1
6B	Courtrock loam, 2 to 7 percent slopes	9	IIe-1 Irrigated	35		---	2
			IVc-1 Dryland	37			
7E	Daxty loam, 15 to 40 percent north slopes	9	VIs	38		3f1	5
8E	Daxty-Rock outcrop complex, 3 to 40 percent slopes	9	VIIs	38		---	--
	Daxty soil	--	-------	--		4f1	5
	Rock outcrop	--	-------	--		---	--
	Lithic Xerochrepts	--	-------	--	Mahogany Rockland	---	5
9	Dayville silt loam	11	IIw-1	35		---	2
10	Dumps	11	VIIIs	38		---	2
11C	Fopiano silty clay loam, 2 to 15 percent slopes	11	VIe	37	Clayey Terrace	---	4
11E	Fopiano silty clay loam, 15 to 40 percent north slopes	11	VIe	37	North Exposure	---	4
12E	Grell very gravelly loam, 7 to 40 percent south slopes	12	VIIs	38	South Exposure	---	4
13E	Grell very gravelly loam, 15 to 40 percent north slopes	12	VIIs	38	Droughty North Exposure	---	4
14E	Gwin-Rockly complex, 3 to 40 percent slopes	13	VIIs	38		---	4
	Gwin soil	--	-------	--	South Exposure	---	--
	Rockly soil	--	-------	--	Scabland	---	--
14F	Gwin-Rockly complex, 40 to 70 percent slopes	13	VIIs	38		---	4
	Gwin soil	--	-------	--	South Exposure	---	--
	Rockly soil	--	-------	--	Scabland	---	--
15F	Gwin-Rock outcrop complex, 40 to 70 percent slopes	13	VIIs	38		---	--
	Gwin soil	--	-------	--	South Exposure	---	4
	Rock outcrop	--	-------	--		---	--
16A	Hack loam, 0 to 3 percent slopes	14	IIe-1 Irrigated	35	Bottom land Fan	---	2
16B	Hack loam, 3 to 7 percent slopes	14	IIe-1 Irrigated	35	Bottom land Fan	---	2
16C	Hack loam, 7 to 12 percent slopes	14	IIIe-1 Irrigated	36	Bottom land Fan	---	2
			IIIe-2 Dryland	36			

Map symbol	Mapping unit	Page	Capability unit		Range site	Woodland group	Wildlife group
			Symbol	Page	Name	Number	Number
17C	Hack gravelly loam, 3 to 15 percent slopes	14	IVe-1 Irrigated	36	Bottom land Fan	---	2
18D	Hack extremely stony loam, 3 to 20 percent slopes	14	VIIs	38	Bottom land Fan	---	2
19E	Hankins silt loam, 10 to 45 percent north slopes	15	VIe	37	----------	3o3	5
20E	Hankins silty clay loam, 5 to 35 percent slopes	15	VIe	37	----------	4o1	5
21C	Helter silt loam, 3 to 15 percent slopes	16	VIe	37	----------	3o2	5
21E	Helter silt loam, 15 to 40 percent slopes	16	VIe	37	----------	3o2	5
21F	Helter silt loam, 40 to 60 percent slopes	16	VIIe	38	----------	3r3	5
22E	Laycock-Logdell complex, 15 to 45 percent north slopes	17	VIs	38	----------	---	5
	Laycock soil	--	-------	--	----------	3f1	--
	Logdell soil	--	-------	--	Mahogany Rockland	---	--
23E	Laycock-Logdell complex, 15 to 45 percent south slopes	17	VIs	38	----------	---	5
	Laycock soil	--	-------	--	----------	4f1	--
	Logdell soil	--	-------	--	Mahogany Rockland	---	--
23F	Laycock-Logdell complex, 45 to 75 percent south slopes	17	VIIs	38	----------	---	5
	Laycock soil	--	-------	--	----------	4f2	--
	Logdell soil	--	-------	--	Mahogany Rockland	---	--
24E	Lemonex stony clay loam, 10 to 45 percent slopes	18	VIe	37	----------	3o1	5
25E	Lemonex-Rock outcrop complex, 3 to 45 percent slopes	18	VIIs	38	----------	---	--
	Lemonex soil	--	-------	--	----------	4x1	5
	Rock outcrop	--	-------	--	----------	---	--
	Lithic Xerochrepts	--	-------	--	Mahogany Rockland	---	5
26F	Lickskillet-Rock outcrop complex, 20 to 70 percent slopes	18	VIIs	38	----------	---	--
	Lickskillet soil	--	-------	--	Droughty South Exposure	---	3
	Rock outcrop	--	-------	--	----------	---	--
27F	Logdell very shaly loam, 45 to 70 percent north slopes	19	VIIs	38	Mahogany Rockland	---	5
28E	McGarr stony loam, 5 to 45 percent slopes	20	VIe	37	----------	3o1	5
28F	McGarr stony loam, 45 to 75 percent slopes	20	VIIe	38	----------	3r2	5
29F	McGarr-Anatone complex, 5 to 65 percent slopes	20	VIIs	38	----------	---	5
	McGarr soil	--	-------	--	----------	4x1	--
	Anatone soil	--	-------	--	Scabland	---	--
30B	Oxbow very stony silty clay loam, 2 to 5 percent slopes	21	IVs-1 Irrigated	37	Droughty Terrace	---	2 Irrigated
			VIs	38			4 Dryland
31B	Oxwall very stony silty clay loam, 2 to 7 percent slopes	21	VIs	38	Droughty Terrace	---	4
32B	Oxwall extremely stony silty clay loam, 2 to 7 percent slopes	21	VIIs	38	Droughty Terrace	---	4
33F	Piersonte-Logdell-Laycock complex, 45 to 70 percent north slopes	22	VIIs	38	----------	---	5
	Piersonte soil	--	-------	--	----------	3f2	--
	Logdell soil	--	-------	--	Mahogany Rockland	---	--
	Laycock soil	--	-------	--	----------	3f2	--
34	Powder silt loam, occasional overflow	23	IIw-2 Irrigated	36	----------	---	2

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Page	Capability unit Symbol	Page	Range site Name	Woodland group Number	Wildlife group Number
35	Ricco silty clay loam	23	IVw-1 Irrigated	37		---	1
36F	Rock outcrop-Lemonex complex, 30 to 75 percent slopes	24	VIIs	38		---	--
	Rock outcrop	--	-------	--		---	--
	Lemonex soil	--	-------	--		4x2	5
	Lithic Xerochrepts	--	-------	--	Mahogany Rockland	---	5
37D	Rockly extremely stony loam, 2 to 20 percent slopes	24	VIIs	38	Scabland	---	4
38E	Ruddley loam, 5 to 40 percent slopes	25	VIe	37		4d2	5
39E	Ruddley-Rock outcrop complex, 5 to 40 percent slopes	25	VIIs	38		---	--
	Ruddley soil	--	-------	--		4d1	5
	Rock outcrop	--	-------	--		---	--
	Lithic Xerochrepts	--	-------	--	Mahogany Rockland	---	5
40E	Simas clay loam, 8 to 30 percent south slopes	26	VIe	37	Droughty South Exposure	---	3
41E	Simas very stony clay loam, 8 to 40 percent south slopes	26	VIIs	38	Droughty South Exposure	---	3
42E	Simas-Day complex, 5 to 40 percent slopes	26	VIIs	38	Droughty South Exposure	---	3
43F	Simas-Badland association, very steep	26	-------	--		---	--
	Simas soil	--	VIIs	38	Droughty South Exposure	---	3
	Badland	--	VIIIe	38		---	--
44E	Simas-Tub association, steep	26	VIIs	38		---	--
	Simas soil	--	-------	--	Droughty South Exposure	---	3
	Tub soil	--	-------	--	North Exposure	---	4
45E	Snell very stony loam, 15 to 40 percent north slopes	27	VIIs	38	North Exposure	---	4
46E	Snell-Anatone complex, 15 to 40 percent north slopes	27	VIIs	38		---	4
	Snell soil	--	-------	--	North Exposure	---	--
	Anatone soil	--	-------	--	Scabland	---	--
46F	Snell-Anatone complex, 40 to 70 percent north slopes	28	VIIs	38		---	4
	Snell soil	--	-------	--	North Exposure	---	--
	Anatone soil	--	-------	--	Scabland	---	--
47E	Top silt loam, 15 to 35 percent slopes	28	VIe	37		3o3	5
47F	Top silt loam, 35 to 65 percent slopes	29	VIIe	38		3r1	5
48E	Tub clay loam, 20 to 40 percent north slopes	29	VIe	37	North Exposure	---	4
48F	Tub clay loam, 40 to 65 percent north slopes	29	VIIe	38	North Exposure	---	4
49D	Tub stony clay loam, 3 to 20 percent slopes	30	VIe-2 Dryland	37	Rolling Hills	---	4
50B	Ukiah stony silty clay loam, 2 to 8 percent slopes	30	IVe-2 Dryland	37	Moist Rolling Hills	---	4
51C	Ukiah very stony silty clay loam, 3 to 15 percent slopes	30	VIIs	38	Moist Rolling Hills	---	4
52E	Ukiah extremely stony silty clay loam, 15 to 50 percent slopes	30	VIIs	38	South Exposure	---	4
53	Veazie loam	31	IIIw-1 Irrigated	36		---	2

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Page	Capability unit Symbol	Capability unit Page	Range site Name	Woodland group Number	Wildlife group Number
54E	Venator very shaly loam, 5 to 40 percent slopes-----	31	VIs	38	Shrubby South Exposure	---	4
55F	Venator-Rock outcrop complex, 40 to 65 percent slopes----------	32	VIIs	38	----------	---	--
	Venator soil----------	--	-------	--	Shrubby South Exposure	---	4
	Rock outcrop----------	--	-------	--	----------	---	--
56E	Waterbury extremely stony silty clay loam, 3 to 40 percent slopes----------	32	VIIs	38	Deep Scabland	---	4
57D	Wrightman-Anatone complex, 2 to 20 percent slopes---	33	VIIs	38	----------	---	4
	Wrightman soil----------	--	-------	--	Shrubby Rolling Hills	---	--
	Anatone soil----------	--	-------	--	Scabland	---	--

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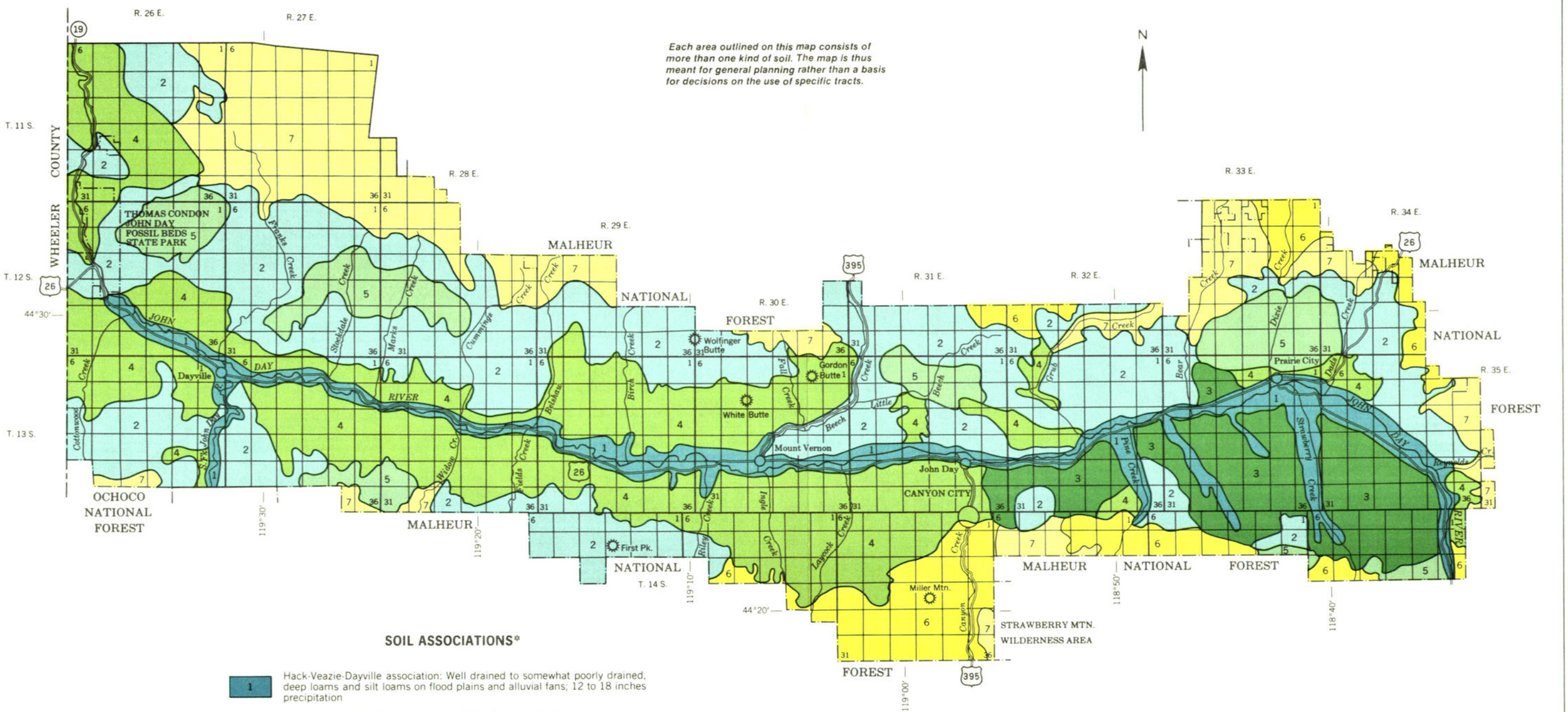
Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.



SOIL ASSOCIATIONS*

1. Hack-Veazie-Dayville association: Well drained to somewhat poorly drained, deep loams and silt loams on flood plains and alluvial fans; 12 to 18 inches precipitation
2. Gwin-Rockly-Lickskillet association: Well drained, shallow very stony or extremely stony loams and silt loams over bedrock on uplands; 11 to 20 inches precipitation
3. Oxwall-Oxbow association: Well drained, shallow and moderately deep very stony and extremely stony silty clay loams over a hardpan on terraces; 14 to 18 inches precipitation
4. Simas-Tub association: Well drained, deep clay loams and stony or very stony clay loams on uplands; 10 to 14 inches precipitation
5. Waterbury-Ukiah association: Well drained, shallow and moderately deep stony to extremely stony silty clay loams over bedrock on uplands; 13 to 20 inches precipitation
6. Lemonex-Laycock-Logdell association: Well drained, moderately deep stony and very stony clay loams over serpentine and deep very shaly loams over highly fractured shale, on uplands; 17 to 24 inches precipitation
7. McGarr-Hankins-Helter association: Well drained, moderately deep and deep silt loams, silty clay loams, stony and very stony loams on uplands; 16 to 30 inches precipitation

*Terms for texture refer to the dominant texture of the surface layer of the major soils.

Compiled 1980

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
OREGON AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

GRANT COUNTY, OREGON, CENTRAL PART

Scale 1: 253,440

1 0 1 2 3 4 5 Miles

INDEX TO MAP SHEETS

GRANT COUNTY, OREGON, CENTRAL PART

Scale 1: 253,440

1 0 1 2 3 4 5 Miles

SOIL LEGEND

Arabic numerals in the symbols indicate the map units. The capital letters A, B, C, D, E or F following the numeral or numerals indicate the slope class. Some symbols without slope class letters are for nearly level soils.

SYMBOL	NAME
1F	Alding-Rock outcrop complex, 30 to 70 percent slopes
2D	Anatone-Wrightman complex, 3 to 25 percent slopes
3C	Balder stony loam, 5 to 15 percent slopes
4F	Balder very stony loam, 15 to 55 percent slopes
5	Boyce silty clay loam
6B	Courtrock loam, 2 to 7 percent slopes
7E	Daxty loam, 15 to 40 percent north slopes
8E	Daxty-Rock outcrop complex, 3 to 40 percent slopes
9	Dayville silt loam
10	Dumps
11C	Fopiano silty clay loam, 2 to 15 percent slopes
11E	Fopiano silty clay loam, 15 to 40 percent north slopes
12E	Grell very gravelly loam, 7 to 40 percent south slopes
13E	Grell very gravelly loam, 15 to 40 percent north slopes
14E	Gwin-Rockly complex, 3 to 40 percent slopes
14F	Gwin-Rockly complex, 40 to 70 percent slopes
15F	Gwin-Rock outcrop complex, 40 to 70 percent slopes
16A	Hack loam, 0 to 3 percent slopes
16B	Hack loam, 3 to 7 percent slopes
16C	Hack loam, 7 to 12 percent slopes
17C	Hack gravelly loam, 3 to 15 percent slopes
18D	Hack extremely stony loam, 3 to 20 percent slopes
19E	Hankins silt loam, 10 to 45 percent north slopes
20E	Hankins silty clay loam, 5 to 35 percent slopes
21C	Helter silt loam, 3 to 15 percent slopes
21E	Helter silt loam, 15 to 40 percent slopes
21F	Helter silt loam, 40 to 60 percent slopes
22E	Laycock-Logdell complex, 15 to 45 percent north slopes
23E	Laycock-Logdell complex, 15 to 45 percent south slopes
23F	Laycock-Logdell complex, 45 to 75 percent south slopes
24E	Lemonex stony clay loam, 10 to 45 percent slopes
25E	Lemonex-Rock outcrop complex, 3 to 45 percent slopes
26F	Lickskillet-Rock outcrop complex, 20 to 70 percent slopes
27F	Logdell very shaly loam, 45 to 70 percent north slopes
28E	McGarr stony loam, 5 to 45 percent slopes
28F	McGarr stony loam, 45 to 75 percent slopes
29F	McGarr-Anatone complex, 5 to 65 percent slopes
30B	Oxbow very stony silty clay loam, 2 to 5 percent slopes
31B	Oxwall very stony silty clay loam, 2 to 7 percent slopes
32B	Oxwall extremely stony silty clay loam, 2 to 7 percent slopes
33F	Piersonte-Logdell-Laycock complex, 45 to 70 percent north slopes
34	Powder silt loam, occasional overflow
35	Ricco silty clay loam
36F	Rock outcrop-Lemonex complex, 30 to 75 percent slopes
37D	Rockly extremely stony loam, 2 to 20 percent slopes
38E	Ruddley loam, 5 to 40 percent slopes
39E	Ruddley-Rock outcrop complex, 5 to 40 percent slopes
40E	Simas clay loam, 8 to 30 percent south slopes
41E	Simas very stony clay loam, 8 to 40 percent south slopes
42E	Simas-Day complex, 5 to 40 percent slopes
43F	Simas-Badland association, very steep
44E	Simas-Tub association, steep
45E	Snell very stony loam, 15 to 40 percent north slopes
46E	Snell-Anatone complex, 15 to 40 percent north slopes
46F	Snell-Anatone complex, 40 to 70 percent north slopes
47E	Top silt loam, 15 to 35 percent slopes
47F	Top silt loam, 35 to 65 percent slopes
48E	Tub clay loam, 20 to 40 percent north slopes
48F	Tub clay loam, 40 to 65 percent north slopes
49D	Tub stony clay loam, 3 to 20 percent slopes
50B	Ukiah stony silty clay loam, 2 to 8 percent slopes
51C	Ukiah very stony silty clay loam, 3 to 15 percent slopes
52E	Ukiah extremely stony silty clay loam, 15 to 50 percent slopes
53	Veazie loam
54E	Venator very shaly loam, 5 to 40 percent slopes
55F	Venator-Rock outcrop complex, 40 to 65 percent slopes
56E	Waterbury extremely stony silty clay loam, 3 to 40 percent slopes
57D	Wrightman-Anatone complex, 2 to 20 percent slopes

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool — Davis Airstrip; FLOOD POOL LINE

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEMS & DESIGNATIONS

- Interstate — 79
- Federal — 410
- State — 52
- County, farm or ranch — 378

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small — water; w

PITS

- Gravel pit — G.P.
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label) — Indian Mound
- Located object (label) — Tower
- Tank (label) — GAS
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end

Canals or ditches

- Double-line (label) — CANAL
- Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial — water; w
- Intermittent — int; i

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS — SvE 107

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

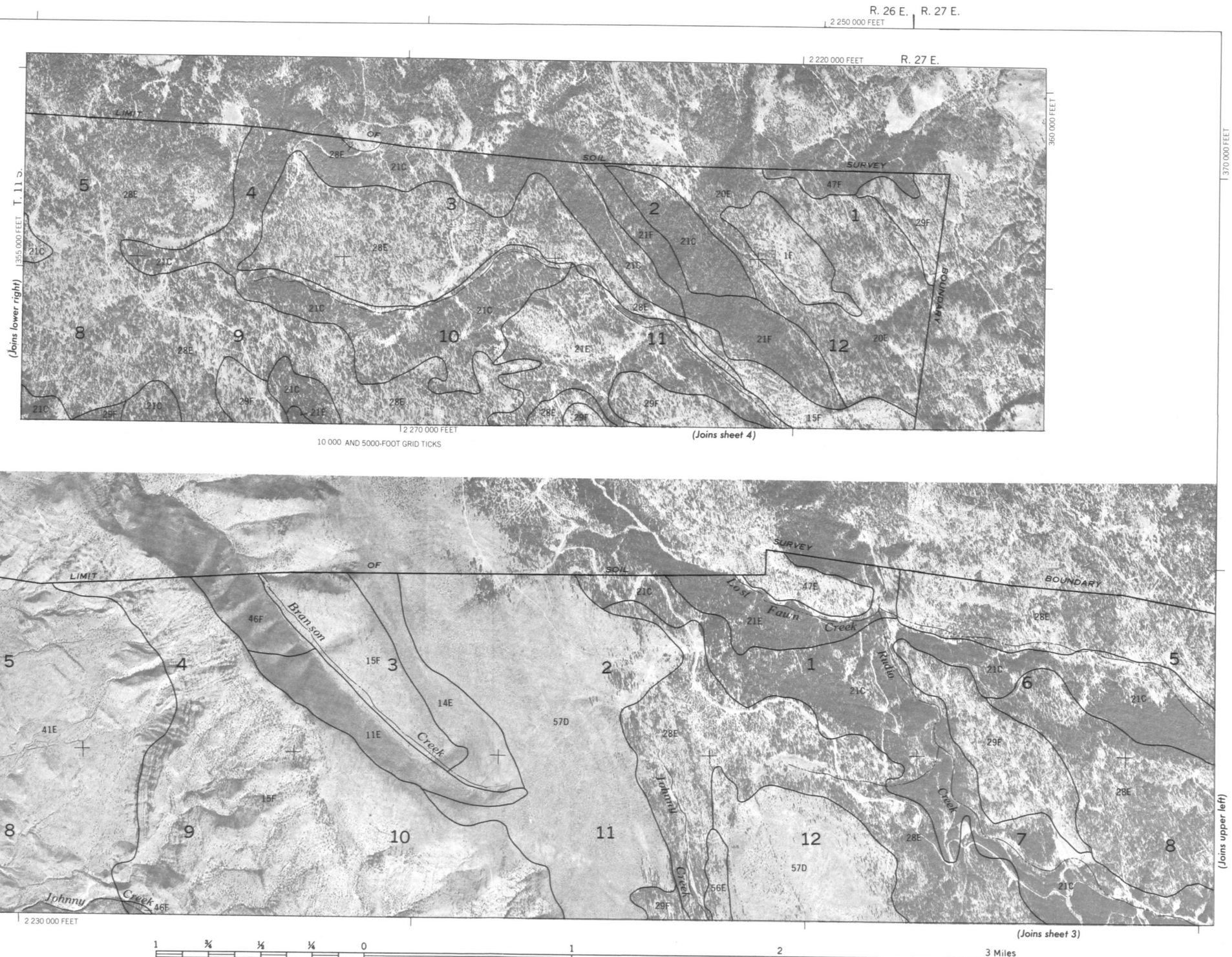
DEPRESSION OR SINK

SOIL SAMPLE SITE (normally not shown) — S

MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot — 0

GRANT COUNTY, OREGON, CENTRAL PART — SHEET NUMBER 1



1 ¾ ½ ¼ 0 1 2 3 Miles

5000 4000 3000 2000 1000 0 5000 10000 15000 Feet

Scale 1:31680

This map was compiled on 1975 U.S. Department of The Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

N

2 200 000 FEET

300 000 FEET

280 000 FEET

270 000 FEET

290 000 FEET

2 220 000 FEET

2 225 000 FEET

R. 26 E.

(Joins lower right)

(Joins inset B, sheet 2)

(Joins sheet 20)

(Joins sheet 11)

(Joins inset, upper left)

T. 13 S.

T. 12 S.

WHEELER COUNTY

OCHOCO NATIONAL FOREST

Cottonwood Creek

Still Gulch

Cottonwood Creek

Cottonwood Basin

Red Gulch

Day Creek

Cottonwood Creek

17 18 19 20 29 30 31 32 5 6 7 8

1 ¾ ½ ¼ 0 1 2 3 Miles

5000 4000 3000 2000 1000 0 5000 10000 15000 Feet

Scale 1:31680

This map was compiled on 1975 U.S. Department of The Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. 10,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

N

(Joins sheet 5)

R. 26 E. | R. 27 E.

2 260 000 FEET

300 000 FEET

T. 13 S. | T. 12 S.

295 000 FEET

(Joins sheet 10)

(Joins sheet 12)

2 230 000 FEET

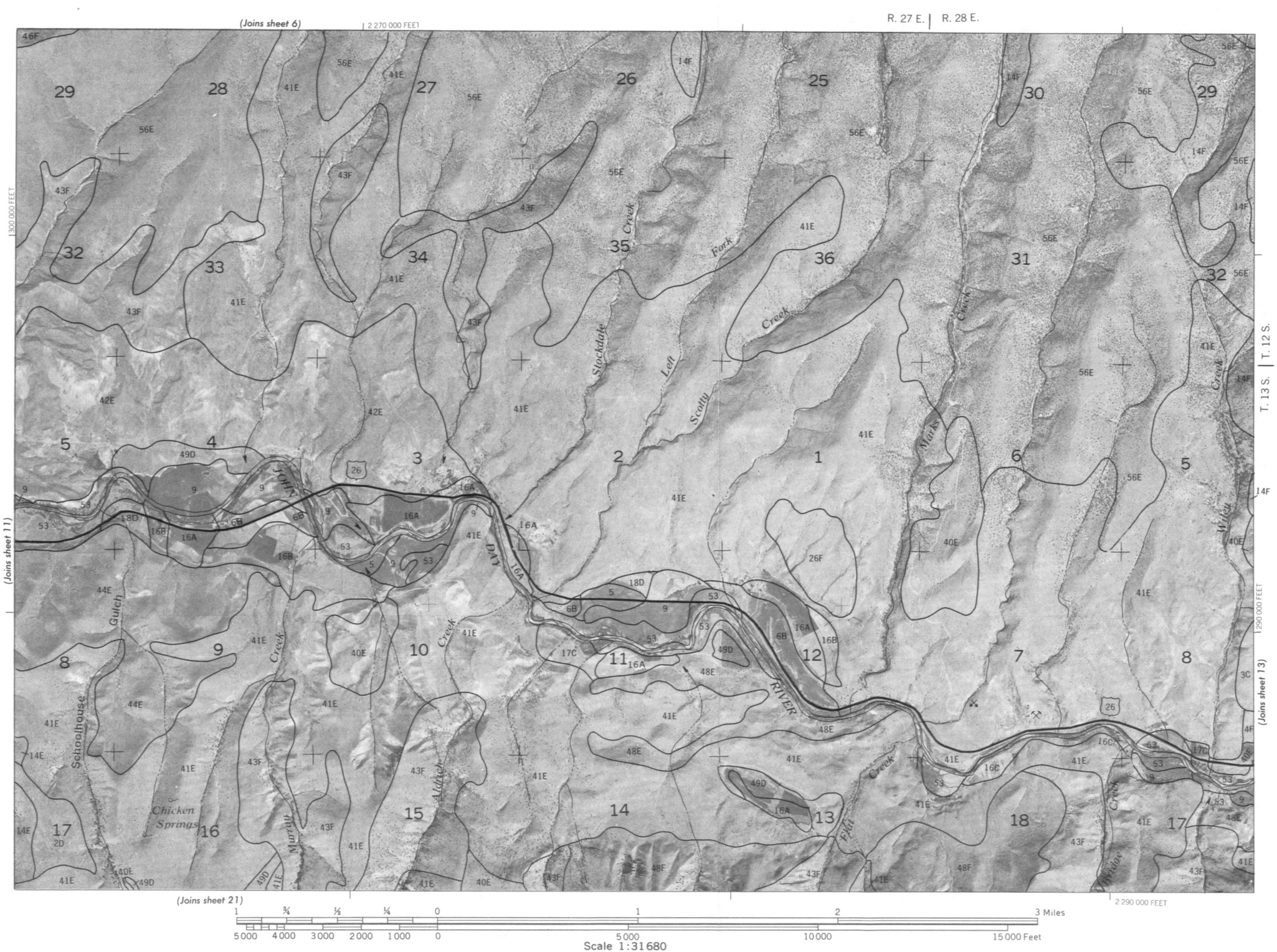
(Joins sheet 20)

Cottonwood Creek
John Day River
Nash Reservoir
Butte Creek
Long Hollow
Ferris Creek
Franks Creek
Table Rock
Keeton Spring
Bracket Spring
Dayville
Conner Spring
South Fork John Day River
Cottonwood Spring
Guyon Creek
Guyon Spring
Gray Gulch
Sandy Hollow
Cottonwood Basin
McIntire Basin
Vanata Basin

1 ¾ ½ ¼ 0 1 2 3 Miles

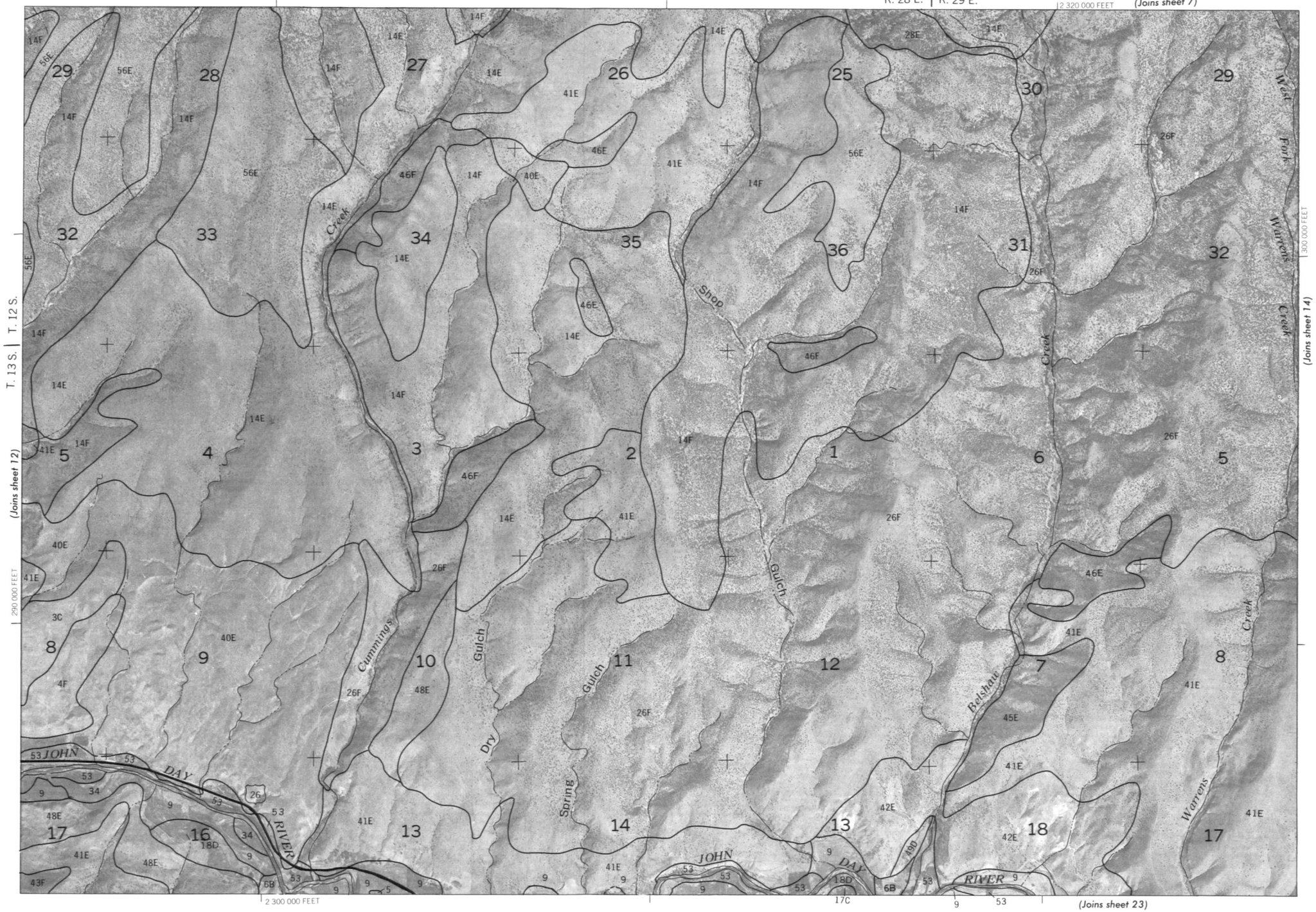
5000 4000 3000 2000 1000 0 5000 10000 15000 Feet

Scale 1:31680



10,000-foot grid ticks based on state coordinate system. Land and division corners, if shown, are approximately positioned.
This map was compiled on 1975 by the U.S. Department of The Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

N



1 ¾ ½ ¼ 0 1 2 3 Miles

5000 4000 3000 2000 1000 0 5000 10000 15000 Feet

Scale 1:31680

N

R. 29 E. | R. 30 E.

2 330 000 FEET

(Joins inset sheet 32)

300 000 FEET

290 000 FEET

T. 13 S. | T. 12 S.

MALHEUR NATIONAL FOREST

SOIL SURVEY BOUNDARY

Wolfinger Butte

Lone Pine Basin

Horse Spring

Warrens Creek

West Fork

East Fork

Dry Creek

Birch Creek

Damon Creek

Clark Creek

Stone Gulch

Waterspout Gulch

Gravelyard Gulch

(Joins sheet 15)

(Joins sheet 23)

2 350 000 FEET

1 ¾ ½ ¼ 0 1 2 3 Miles

5000 4000 3000 2000 1000 0 5000 10000 15000 Feet

Scale 1:31680

10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

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N

1 ¾ ½ ¼ 0 1 2 3 Miles

5000 4000 3000 2000 1000 0 5000 10000 15000 Feet

Scale 1:31680

N

This map was compiled on 1975 U.S. Department of The Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
10,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

N

R. 32 E. | R. 33 E.

T. 13 S. | T. 12 S.

2 450 000 FEET

1 300 000 FEET

1 290 000 FEET

2 430 000 FEET

(Joins inset, sheet 9)

(Joins sheet 16)

(Joins sheet 18)

(Joins sheet 26)

MALHEUR NATIONAL FOREST

Butch Foster Saddle

Cottonwood Spring

Hardy Spring

Grub Creek

Gulch

Deep Gulch

Coyote Creek

Castle Creek

Bear Creek

JOHN DAY RIVER

1 ¾ ½ ¼ 0 1 2 3 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 10 000 15 000 Feet

Scale 1:31 680

18

N

GRANT COUNTY, OREGON, CENTRAL PART — SHEET NUMBER 18

2 460 000 FEET

(Joins sheet 8)

R. 33 E. | R. 34 E.

T. 12 S. | T. 13 S

(Joins sheet 17)

290 000 FEET

Prairie City

JOHN DAY RIVER

Slaughterhouse Gulch

Dixie Creek

Squaw Creek

Strawberry Creek

Clark Creek

Davis Creek

Jeff Davis

Shaw Gulch

(Joins sheet 27)

2 480 000 FEET

290 000 FEET

1 ¾ ½ ¼ 0 1 2 3 Miles

5000 4000 3000 2000 1000 0 5000 10000 15000 Feet

Scale 1:31680

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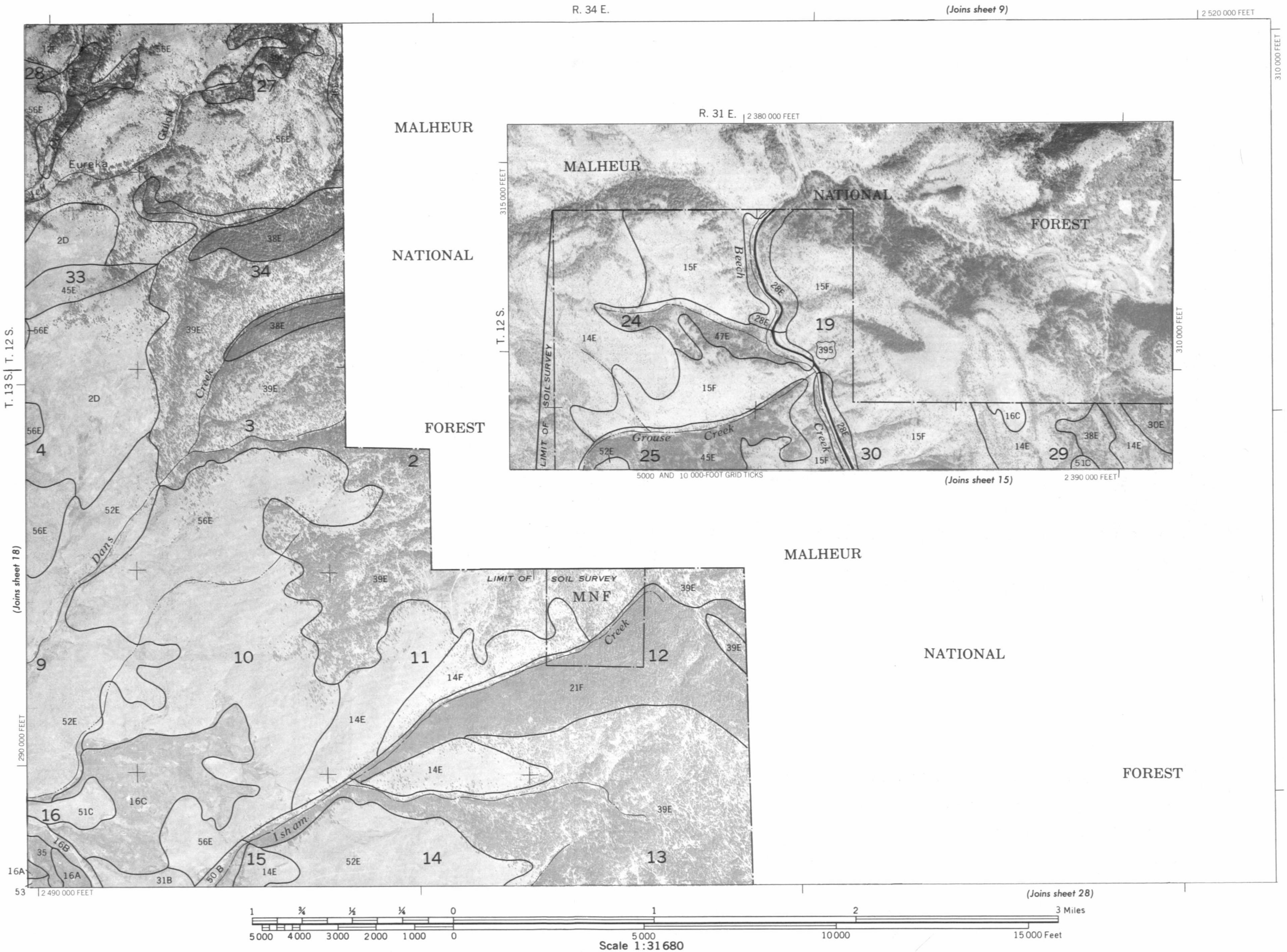
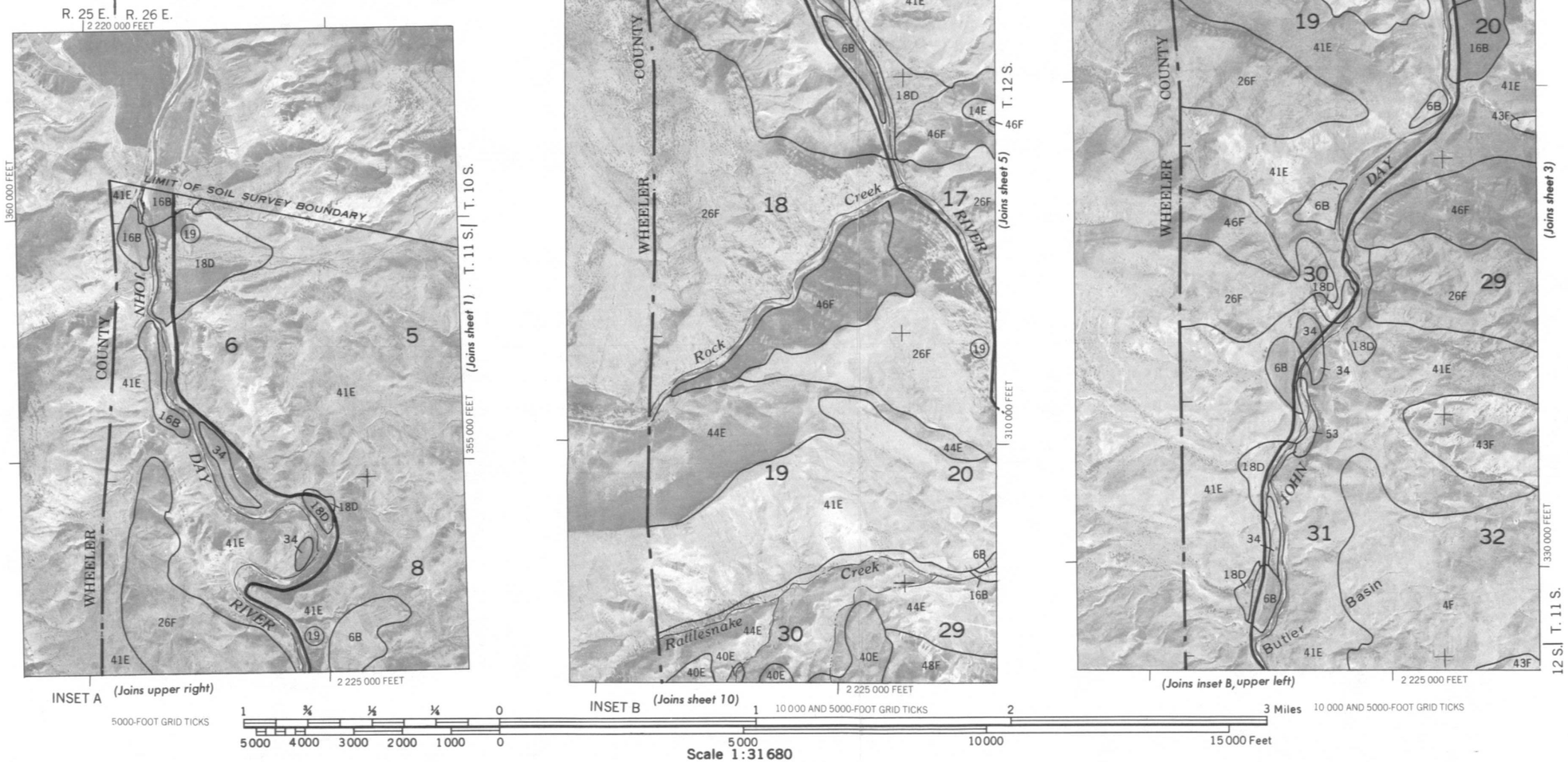
10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.



This map was compiled on 1975 U.S. Department of The Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

N

GRANT COUNTY, OREGON, CENTRAL PART — SHEET NUMBER 2



N

2 230 000 FEET

(Joins sheet 11)

R. 26 E. | R. 27 E.

280 000 FEET

(Joins inset, sheet 10)

McNulty Basin

McIntire Basin

Vanata Basin

South Fork Basin

Long Hollow

Johnson Creek

Battle Creek

Tunnel Creek

Deep River

John Day River

South Fork John Day River

Smokey Creek

LIMIT OF SOIL SURVEY BOUNDARY

OCHOCO NATIONAL FOREST

270 000 FEET

(Joins sheet 21)

T. 13 S.

2 260 000 FEET

2 400 000 FEET

R. 31 E. R. 32 E.

WALLOWA-WHITMAN NATIONAL FOREST

310 000 FEET

(Joins inset, sheet 19)

305 000 FEET

(Joins inset, sheet 6)

T. 12 S.

(Joins sheet 16)

2 420 000 FEET

1000 AND 10 000-FOOT GRID TICKS

1 ¾ ½ ¼ 0 1 2 3 Miles

5000 4000 3000 2000 1000 0 5000 10000 15000 Feet

Scale 1:31 680

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10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

N

R. 27 E. | R. 28 E. (Joins sheet 12)

2 290 000 FEET

(Joins sheet 22) 280 000 FEET

(Joins sheet 20) T. 14 S. | T. 13 S.

2 270 000 FEET

MALHEUR NATIONAL FOREST

LIMIT OF SOIL SURVEY BOUNDARY

Gray Gulch Creek

Murray Creek

Aldrich Creek

Flat Creek

Bridge Creek

Little Bridge Creek

Grouse Creek

Roosevelt Lake

Stewart Lake

Whites Creek

1 ¾ ½ ¼ 0 1 2 3 Miles

5000 4000 3000 2000 1000 0 5000 10000 15000 Feet

Scale 1:31 680

N

GRANT COUNTY, OREGON, CENTRAL PART — SHEET NUMBER 22

1 ¾ ½ ¼ 0 1 2 3 Miles

5000 4000 3000 2000 1000 0 5000 10000 15000 Feet

Scale 1:31680

This map was compiled on 1975 U.S. Department of The Interior. Geological Survey orthophotography by the U.S. Department of Agriculture. Soil Conservation Service and cooperating agencies.
10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

N

R. 29 E. | R. 30 E. | 2 350 000 FEET

(Joins sheet 14)

(Joins sheet 24)

280 000 FEET

290 000 FEET

T. 14 S. | T. 13 S.

(Joins sheet 22)

2 330 000 FEET

(Joins sheet 29)

Graveyard Gulch
Waterspout Gulch
Yokom Reservoir
Birch Creek
Dry Creek
Damon Creek
Clark Creek
Stone Gulch
JOHN DAY RIVER
Second Creek
First Creek
Moon Creek
Star Gulch
Ran Gulch
McClellan Creek
Barnard Gulch
Riley Creek
Capsuttle Creek
Harper Gulch
Red Gulch

1 ¾ ½ ¼ 0 1 2 3 Miles
5000 4000 3000 2000 1000 0 5000 10000 15000 Feet
Scale 1:31 680

GRANT COUNTY, OREGON, CENTRAL PART — SHEET NUMBER 24

N

2 360 000 FEET

(Joins sheet 15)

42E 12E

R. 30 E. | R. 31 E.

280 000 FEET

(Joins sheet 23)

Mount Vernon

CLYDE HOLLIDAY STATE PARK

RIVER

JOHN DAY

Mount Vernon Beach

Gulch

Quartz Gulch

Creek

Angel Gulch

Graveyard Gulch

Lee Creek

Hamer Creek

Hess Creek

Laycock Creek

East Fork Luce Creek

Luce Creek

Bald Hill

270 000 FEET

T. 14 S. | T. 13 S. (Joins sheet 24)

(Joins sheet 30)

2 390 000 FEET

1 ¾ ½ ¼ 0 1 2 3 Miles

5000 4000 3000 2000 1000 0 5000 10000 15000 Feet

Scale 1:31680

10,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

This map was compiled on 1975 U.S. Department of The Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

N

R. 31 E. | R. 32 E.

(Joins sheet 16)

2 420 000 FEET

280 000 FEET

(Joins sheet 26)

270 000 FEET

T. 14 S. | T. 13 S.

(Joins sheet 24)

2 400 000 FEET

(Joins sheet 31)

Canyon City (county seat)

JOHN DAY

JOHN DAY RIVER

Davis Creek

Chimney Creek

Canyon Creek

Long Gulch

Gulch

Blue Gulch

Whiskey Gulch

Little Dog Creek

Little Pine Creek

Dog Creek

Luce Gulch

Fork

CEMETERY

1 ¾ ½ ¼ 0 1 2 3 Miles

5000 4000 3000 2000 1000 0 5000 10000 15000 Feet

Scale 1:31 680

GRANT COUNTY, OREGON, CENTRAL PART — SHEET NUMBER 26

N

2 430 000 FEET

(Joins sheet 17)

R. 32 E. | R. 33 E.

280 000 FEET

T. 14 S. | T. 13 S.

270 000 FEET

(Joins sheet 25)

(Joins sheet 27)

(Joins inset, sheet 33)

2 450 000 FEET

1 ¾ ½ ¼ 0 1 2 3 Miles

5000 4000 3000 2000 1000 0 5000 10000 15000 Feet

Scale 1:31 680

10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

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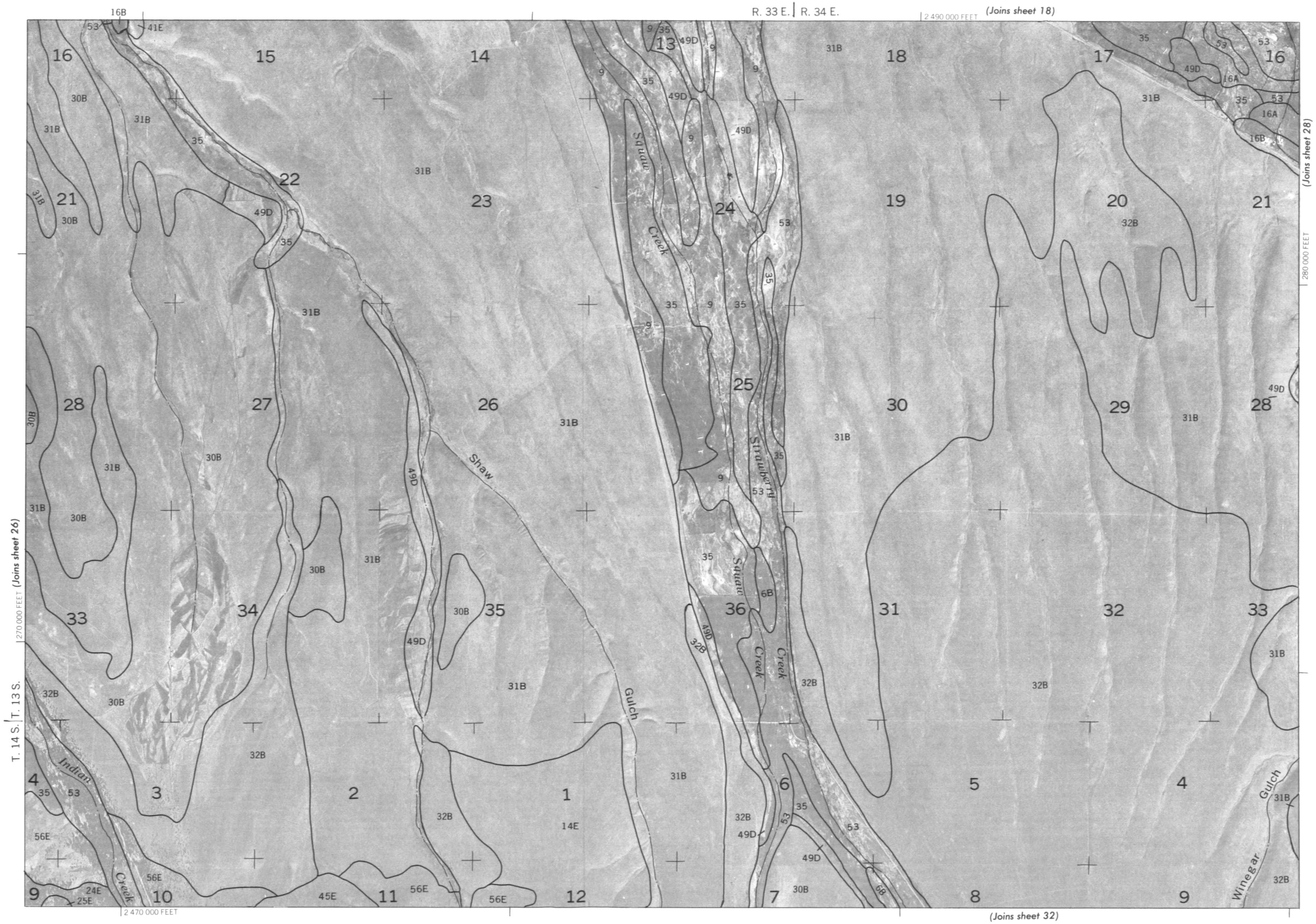

1 ¾ ½ ¼ 0 1 2 3 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 10 000 15 000 Feet

Scale 1:31 680

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GRANT COUNTY, OREGON, CENTRAL PART — SHEET NUMBER 28

N

2 490 000

R. 34 E. | R. 35 E.

(Joins sheet 19)

280 000 FEET

(Joins sheet 27)

WHITMAN NATIONAL FOREST

2 520 000 FEET

T. 14 S. T. 13 S.

270 000 FEET

(Joins sheet 33)

1 ¾ ½ ¼ 0 1 2 3 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 10 000 15 000 Feet

Scale 1:31 680

10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

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N

R. 29 E. | R. 30 E.

2 350 000 FEET

(Joins sheet 23)

T. 14 S.

(Joins inset, sheet 31)

260 000 FEET

(Joins sheet 30)

Third Cr.

Moon Creek

First Peak

Rim Creek

McClellan Creek

Buck Gulch

Rilau Creek

Capsattle Creek

MALHEUR NATIONAL FOREST

LIMIT OF SOIL SURVEY BOUNDARY

INSET A (Joins sheet 30)

R. 30 E. | R. 31 E.

2 390 000 FEET

T. 14 S.

2 360 000 FEET

2 380 000 FEET

(Joins inset B, sheet 29)

Honeycomb Creek

MALHEUR NATIONAL FOREST

R. 31 E.

49D INSET B (Joins sheet 31)

2 410 000 FEET

(Joins inset A, sheet 29)

T. 14 S.

236 000 FEET

238 000 FEET

240 000 FEET

Big Rock

Cummings Cr.

MALHEUR NATIONAL FOREST

2 400 000 FEET

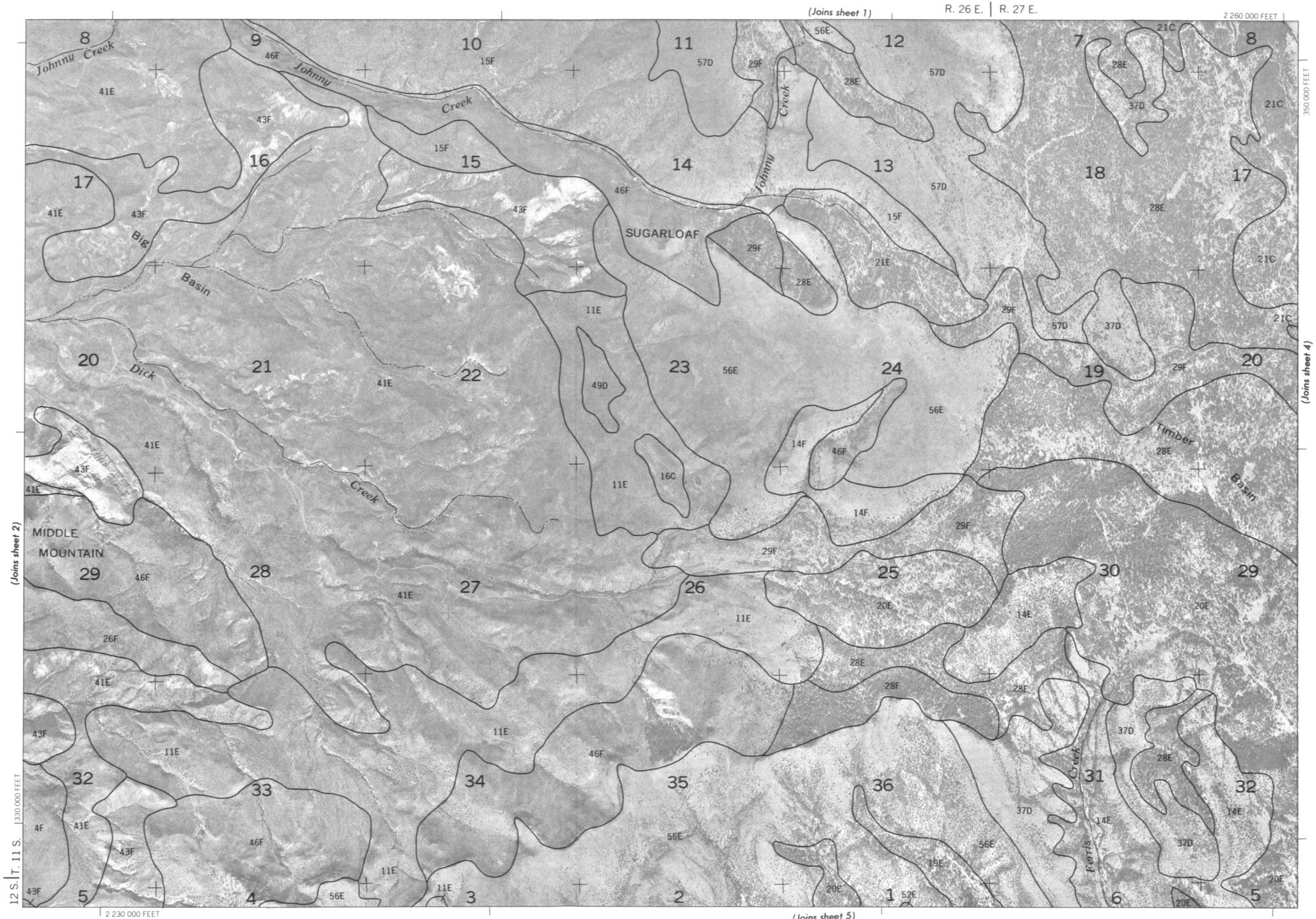
2 330 000 FEET

1 ¾ ½ ¼ 0 1 2 3 Miles

5000 4000 3000 2000 1000 0 5000 10000 15000 Feet

Scale 1:31680

GRANT COUNTY, OREGON, CENTRAL PART — SHEET NUMBER 3



1 ¾ ½ ¼ 0 1 2 3 Miles

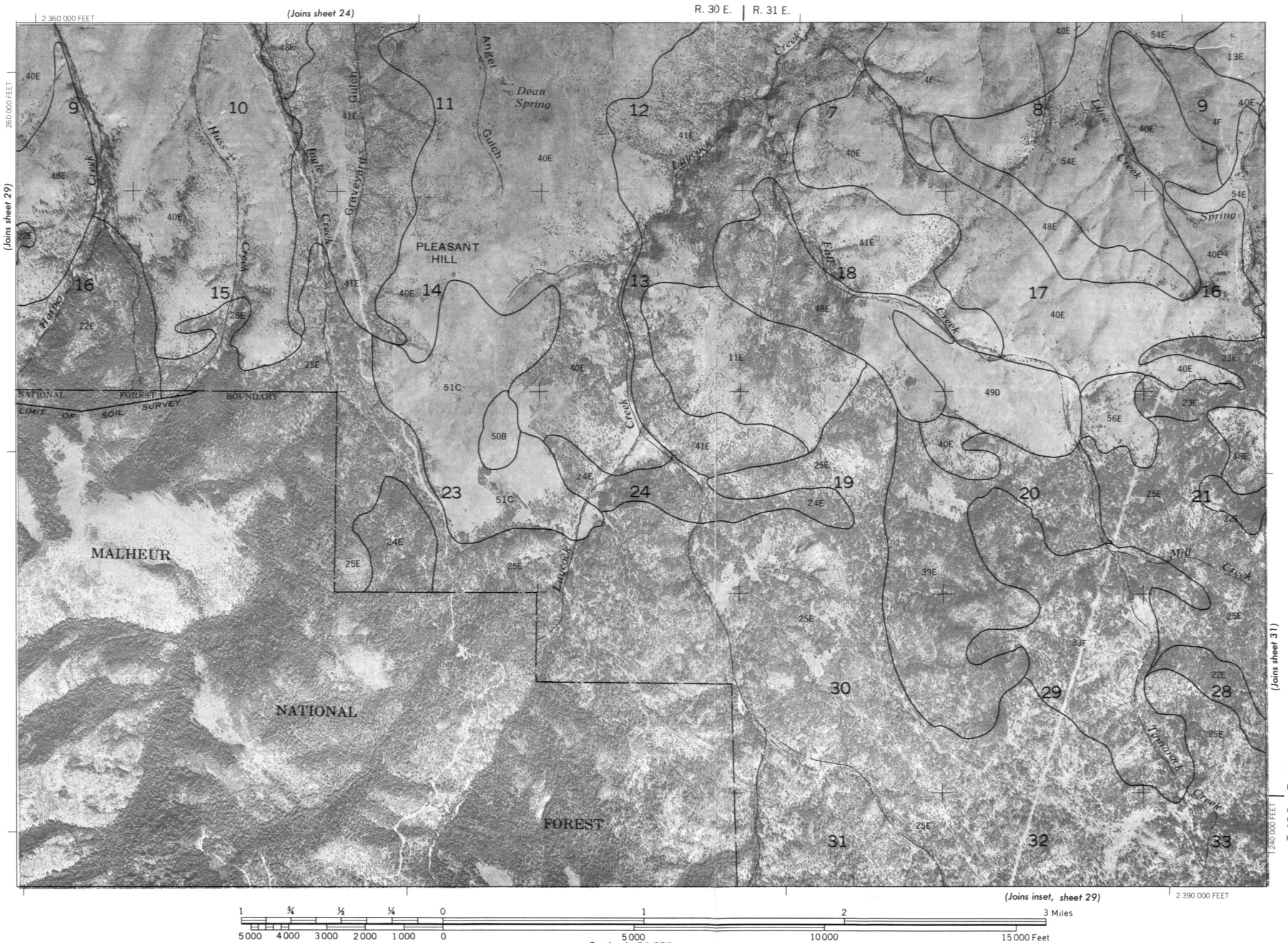
5000 4000 3000 2000 1000 0 5000 10000 15000 Feet

Scale 1:31680

30

N

GRANT COUNTY, OREGON, CENTRAL PART — SHEET NUMBER 30



N

R. 31 E. | R. 32 E.

(Joins sheet 25)

2 420 000 FEET

260 000 FEET

(Joins inset, sheet 33)

T. 14 S.

(Joins sheet 30)

240 000 FEET

2 400 000 FEET

(Joins inset B, sheet 29)

R. 29 E.

(Joins sheet 22)

2 325 000 FEET

260 000 FEET

(Joins sheet 29)

T. 14 S.

250 000 FEET

2 230 000 FEET

10 000 AND 5000-FOOT GRID TICKS

Eagle Peak

Little Canyon Mt

Miller Mountain

Byram Gulch

Sheep Gulch

Canyon Creek

Big Canyon

First Cr.

Second Creek

Third Creek

NATIONAL FOREST

MALHEUR NATIONAL FOREST

395

53

1 ¾ ½ ¼ 0 1 2 3 Miles

5000 4000 3000 2000 1000 0 5000 10000 15000 Feet

Scale 1:31680

N

2 460 000 FEET

(Joins sheet 27)

R. 33 E. | R. 34 E.

(Joins inset, sheet 33)

260 000 FEET

MALHEUR NATIONAL FOREST

T. 14 S.

(Joins sheet 33)

2 230 000 FEET

R. 29 E.

315 000 FEET

(Joins sheet 7)

MALHEUR NATIONAL FOREST

MALHEUR NATIONAL FOREST

LIMIT OF NATIONAL FOREST SOIL SURVEY BOUNDARY

T. 12 S.

310 000 FEET

250 000 FEET

(Joins sheet 14)

2 250 000 FEET

2 490 000 FEET

1 ¾ ½ ¼ 0 1 2 3 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 10 000 15 000 Feet

Scale 1:31 680

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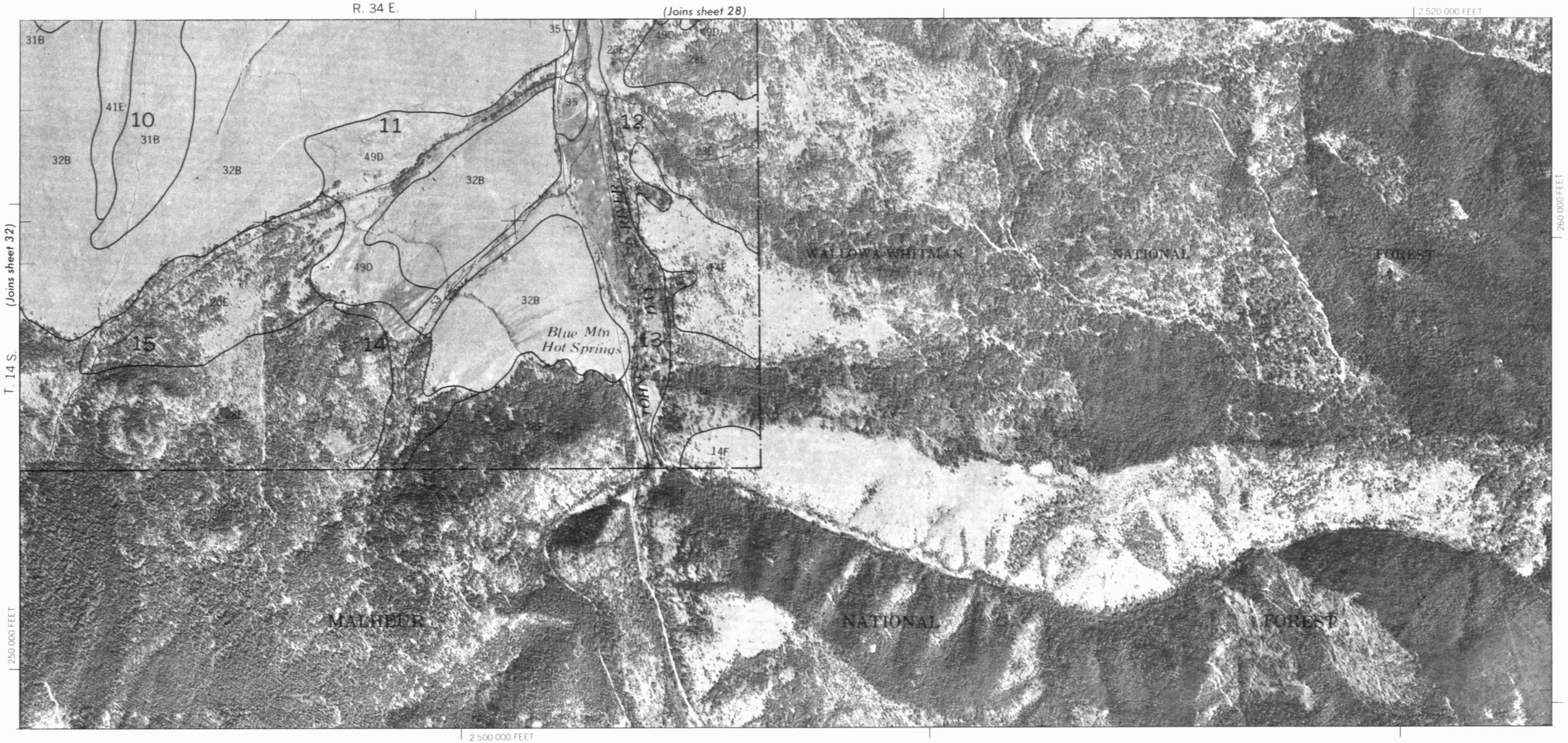
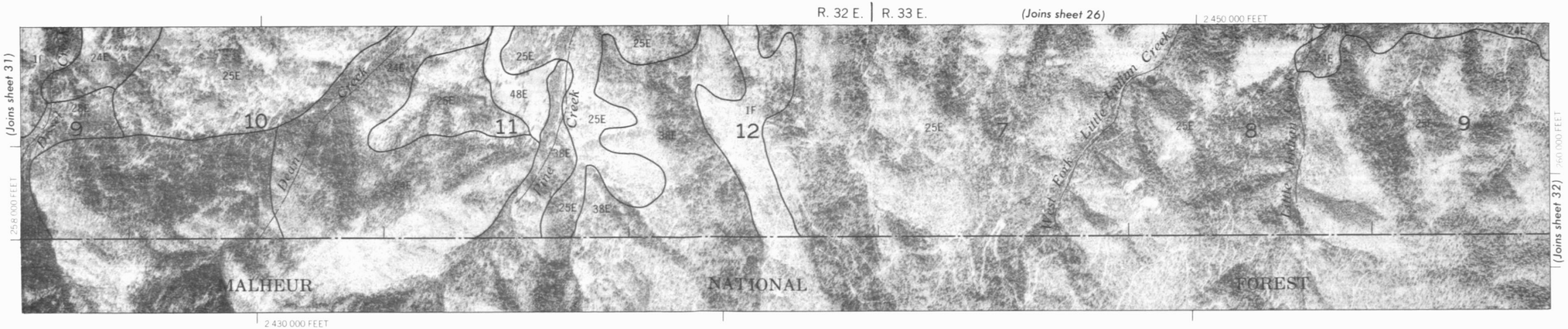
10,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

N





1 ¾ ½ ¼ 0 1 2 3 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 10 000 15 000 Feet

Scale 1:31 680

10 000- AND 2000-FOOT GRID TICKS

GRANT COUNTY, OREGON, CENTRAL PART — SHEET NUMBER 4

N

2 270 000 FEET

(Joins inset, sheet 1)

R. 27 E. | R. 28 E.

355 000 FEET

MALHEUR NATIONAL FOREST

SURVEY BOUNDARY

Rudio Mountain

Caudle Creek

Grizzly Flats

Sheep Ridge

Timber Basin

(Joins sheet 3)

(Joins inset, sheet 7)

(Joins sheet 6)

2 290 000 FEET

330 000 FEET

11 S. | T. 10 S.

1 ¾ ½ ¼ 0 1 2 3 Miles

5000 4000 3000 2000 1000 0 5000 10000 15000 Feet

Scale 1:31680

10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

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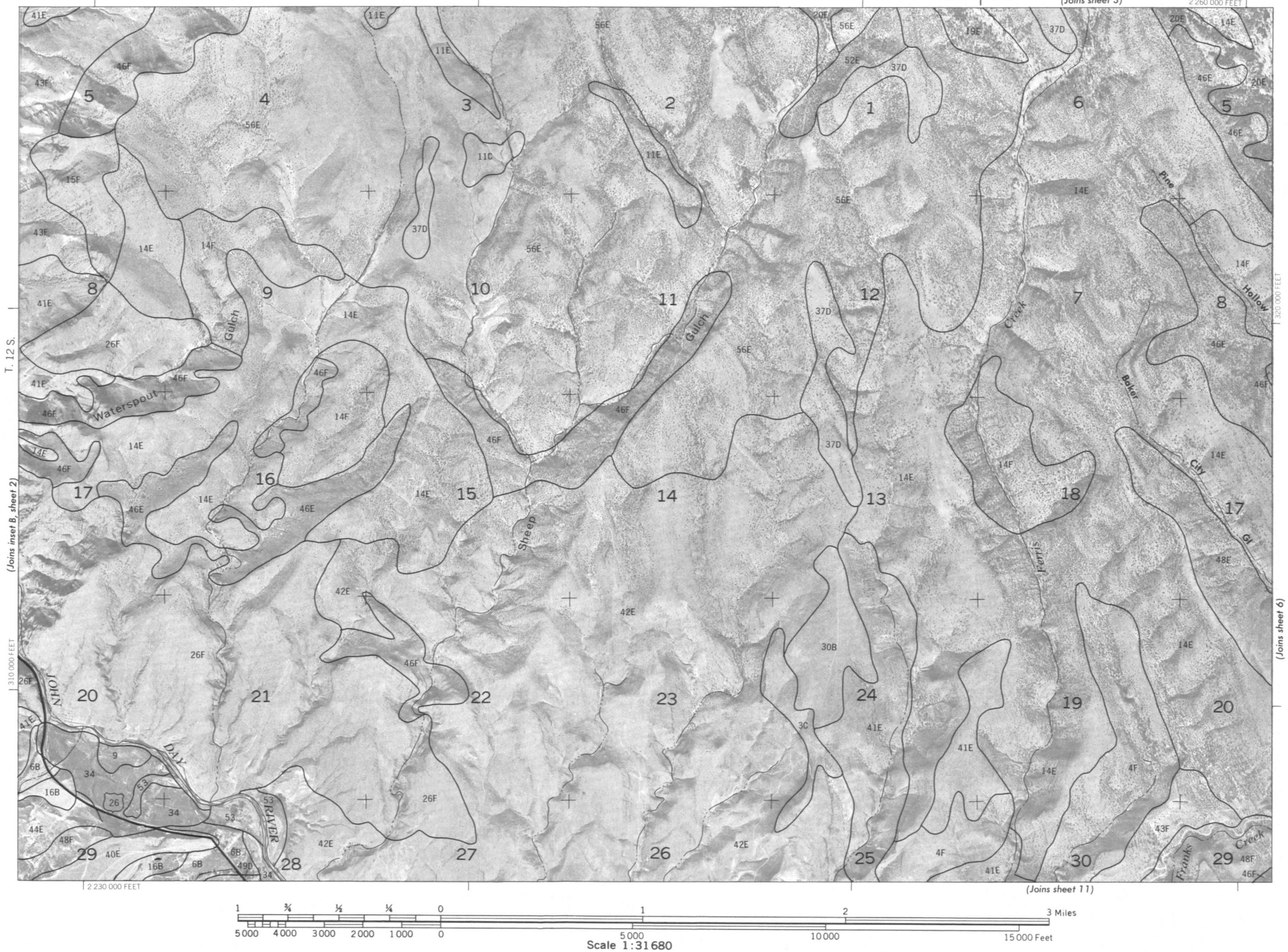

N

GRANT COUNTY, OREGON, CENTRAL PART — SHEET NUMBER 6

(Joins sheet 4)

2 270 000 FEET

R. 27 E. | R. 28 E.

(Joins sheet 5)

320 000 FEET

T. 12 S.

(Joins sheet 7)

310 000 FEET

(Joins sheet 12)

2 290 000 FEET

Franks Creek

Pine Creek

Hollow

Baker Creek

Stockdale Creek

Scotty Creek

Monks Creek

Wiley Creek

1 ¾ ½ ¼ 0 1 2 3 Miles

5000 4000 3000 2000 1000 0 5000 10000 15000 Feet

Scale 1:31 680

1 0,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.
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N

(Joins lower right)

2 320 000 FEET

2 300 000 FEET

MALHEUR NATIONAL FOREST

MALHEUR NATIONAL FOREST

T. 12 S. | T. 11 S. (Joins sheet 4)

330 000 FEET

335 000 FEET

320 000 FEET

2 295 000 FEET

(Joins upper left)

10 000 AND 5000-FOOT GRID TICKS

LIMIT OF SOIL SURVEY BOUNDARY

T. 12 S.

(Joins sheet 6)

310 000 FEET

Cummings Creek

Belshaw Creek

(Joins inset, sheet 32)

2 300 000 FEET

(Joins sheet 13)

1 ¾ ½ ¼ 0 1 2 3 Miles

5000 4000 3000 2000 1000 0 5000 10000 15000 Feet

Scale 1:31680

8

N

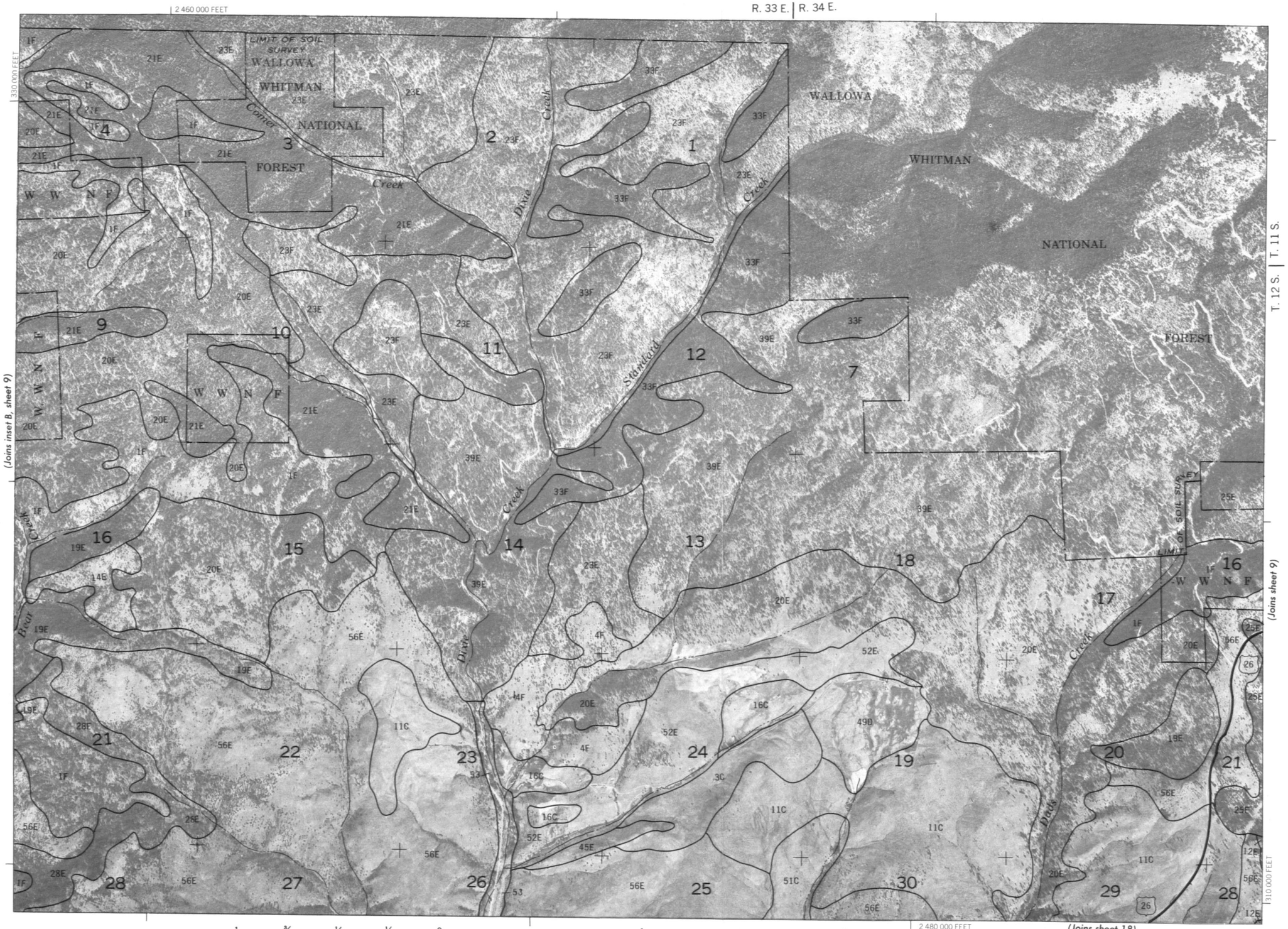
GRANT COUNTY, OREGON, CENTRAL PART — SHEET NUMBER 8

2 460 000 FEET

R. 33 E. | R. 34 E.

330 000 FEET

T. 12 S. | T. 11 S.



2 480 000 FEET

310 000 FEET

1 ¾ ½ ¼ 0 1 2 3 Miles

5000 4000 3000 2000 1000 0 5000 10000 15000 Feet

Scale 1:31680

10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of The Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

N